THE COST OF PRODUCTION

THE PRINCIPLES OF THE SCIENCE OF COSTS, WITH ILLUSTRATIVE EXAMPLES BY COST EXPERTS FOR VARIOUS LINES OF MANUFACTURING INDUSTRY

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PREFACE

The development of manufacturing and the interests closely related to it has seen a corresponding growth in the science of costs. Nowhere has the application of scientific methods to the productive end of a business yielded larger returns than here. The productive sciences are so closely and intimately related to cost reduction that increased production calls for and demands with increase in volume of a product a corresponding decrease in its cost.

The reasons for this demand are manifold. They are at the same time empirical and scientific. Empiricism arbitrarily demands reduced cost. Scientific methods show how cost reduction can be effected.

Contrary to general opinion, there is considerable literature extant on the science of costs. Several works treat the subject from their individual standpoints; many papers of great merit have been presented before various engineering, auditing, and bookkeeping societies, and the technical press—ever to the fore in disseminating valuable information—has been, perhaps,

the most important medium of all for furthering the work.

All literature on this important subject seems to have been included in either of two classes: either an exposition of a working system or systems, or an unrelated set of statements concerning the science. In this work an attempt has been made to give an exposition of the science from a broad standpoint applicable to any business; to arrange the elements in logical order, giving due weight to proper authorities; to unify and blend the whole so as to furnish true information to the student of the science and at the same time not be too elementary for the experienced cost expert. Finally, a number of cost systems with forms have been added, as operated by various experts in this particular line, with the idea of making a work of real worth to those wishing exact information on this subject.

Careful search has been made of all the available literature on the subject, a large number of manufacturing plants have been investigated and numerous personal interviews have been had with those conversant with the subject of costs in order to secure the information necessary for a work of this character.

It is hoped that the information here set forth will

be found of service and add its required quota to the upbuilding of the business sciences, at the same time maintaining the high standard set by the preceding volumes of the Business Man's library, of which this book is the third number.

THE AUTHOR.

Chicago, March 1, 1905.

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THE COST OF PRODUCTION

PART I

THE SCIENCE OF COSTS

CHAPTER I

UTILITY OF A COST SYSTEM

The fact that supply and demand sets the price of a product, seems on its face to be an argument against the use of cost systems, but a moment's consideration shows otherwise. Demand, in these days of advertising, may be created, and after creation, cultivated to a point where it becomes profitable. At what point does it become a profitable one? An accurate cost system answers the question. Then, too, when demand is slack, how far can the producer lower his price in order to stimulate orders? Not permanently below the cost of production, or he will force himself out of business.

The Price of a Competitor no Guide

The method of setting prices by the price obtained by a competitor is too nearly akin to the old rule of thumb to be seriously considered. Yet it is a custom that is held to by many manufacturers on the theory that the price affording "the other fellow" a living profit will do for them. This is nowhere more plainly shown than in the sale of fire insurance. The rate at which a risk can be carried is determined by the concerted action of the leading companies, and the others accept those ratings

as final, and take them as a guide, though the cost to the various companies to carry the same risk may vary greatly. Small firms, trailing a larger one, resort most to this method of price making.

The need of a cost system is nowhere more emphasized than in the meeting of competition. The stock argument of the entire fraternity of buyers is, "'So-and-so' can sell me the same goods for 'so much' less." Age can not wither nor custom stale this plea of the buyer. It is the one remark which, express or implied, enters into the preliminaries of nearly every contract known to law. A comprehensive and accurate cost system can answer under such conditions, whether or not such competition can be met, and if not, the proposition can be declined with the absolute surety that money is being made by such declination.

The Argument of Lower Price

As a class of businesses run without regard to the cost of the finished product, the small country printers stand as an example. Job work is an adjunct to the regular business of getting the paper, and money received therefrom is regarded as a pick-up as compared with the slower yielding subscription list. Prices are made almost by guess or to meet the price the customer says was made him by the other shop. What is the result? The printer finds himself with a depreciated plant, the best years of his life spent, and no means of renewing either. He is the victim of a vicious cost system—or

Printing and Costs

rather lack of system. Costs accurately figured and persistently lived up to, would have one of two results: Prices would be raised to a living rate, or he would seek some business where such prices could be obtained.

This idea is taken up by the American Printer in the following words:

The Collar-Button Man and the Printer

"How many printers passing through the crowded streets of a city, would expect to find in the humble 'collar-button man,' standing on the edge of the sidewalk to hawk his illusive gilded wares, one more businesswise than himself? And yet this vendor's method adopted by the printer, would often raise him from the discomforts of a meager income to the enjoyment of a 'good thing.' It would all hinge upon the known cost of the merchandise being handled. The street tradesman knows that his buttons cost him one cent each; and that, if he sells one for five cents he is four cents to the good. The proposition for him is simplified, in that he pays no rent, employs no help—sets no type, and is free from the eagle eye of the paper man. But, nevertheless, the printer would do well to absorb the main fact here involved; that when actual cost is known a price is possible that shall include a profit; and the profit, we assume, is the chief reason that influences a printer to give up his days and nights to the occupation that engages him. Then it is up to said printer to make his prices include the costs—all of them; else he will come out of the small end of the horn with nothing at hand

more tangible than noise. The first step toward price-making that shall include costs is the installation of such a system as will secure exact knowledge of these costs. * * * The most vital need of the new year for a great many of our readers is, confessedly, the adoption of a cost system that shall enable the proprietor of a printing plant to know what to charge for his output, based on what it costs him to produce it. * * * We hope this matter of 'known costs' will have the attention it deserves at the hands of printers prone to ignore it."

From the standpoint of the manufacturer, the need of a cost system is even more pressing, as his investment is usually large and coupled with interests which are far-reaching in extent.

Speaking on the subject of "Cost Computation," retiring President F. E. Meyers of the National Association of Agricultural Implement and Vehicle Manufacturers, at their recent convention at Chattanooga, said:

"Unless manufacturers study costs carefully, they are simply groping in the dark. They may possibly make money, but it is more likely that without a knowledge of what their products are costing them, they will surely run into the hands of a receiver.

"Inquiry into the cause of failure of a few esteemed business friends reveals the fact that they were deceived by their superintendents and foremen, who had

made false calculations and statements concerning the cost of material, labor, etc.

"It is manifest that we should take this matter into our own hands and on an intelligent basis make our price, regardless of what others do.

"The American manufacturer to be successful must be an economist, know exact costs and have the courage to abandon slipshod ways of product."

As a record acting as a business guide, a satisfactory system of cost keeping is unexcelled. One cost account standing alone is valueless—an industrial waif of most uncertain status—but as a part of a systematic record it becomes as useful as a guide as a compass is to a ship. The value of costs lies entirely in comparison. The comparative records of cost of a machine or product become of immense value in determining the future of a business proposition, the efficiency of the management in the past, and a thousand and one intermeshing questions often coming up in the administration of affairs.

While as a general proposition it may be said that the value of a cost-keeping system varies in value directly as its completeness, there may be, of course, limiting circumstances which qualify such statement. In a factory having a monopoly of a certain electrical machine, because of the ownership of controlling patents, these machines not being subject to competition, and put out at a profit of 200 to 300 per cent,

a rudimentary cost system would do. In an iron or steel works subject to the severest competition, the most detailed cost system possible would be required.

A thorough understanding of the value and efficacy of labor is one of the important results of a proper system of costs. If the employer has at all times positive information as to the productiveness of the individual employé, he not only has the means of putting the employé upon a just and equitable wage basis, but he has also a means of protection against strikes called because of the discharge of inefficient workmen. Not only does the fact that a close and accurate daily efficiency record is being kept, incite the employé to better efforts, but it restrains him from making unreasonable demands—demands which may be the beginning of strike agitation. Much might be said on this point—also on the need of a far-reaching and accurate check on the time-reports of both foremen and employés—but the experience of the employer is open to anyone who cares to interview him.

Costs and Labor

CHAPTER II

DEVELOPMENT OF THE SCIENCE OF COSTS

The history of the cost of the made or manufactured product lies well within the developments of the last few decades, particularly in the United States. The reason for this is three-fold: First, the wonderful natural resources of the United States; second, the tendency to lower prices caused by competition; third, the influence of trusts and combinations.

Early Natural Advantages

The early settlers in this country found a virgin field for every species of undertaking. The soil was rich, producing limitless crops; the forests of wide extent, with timber to be had for the taking; and the various minerals only needed bringing to the surface and the rudest metallurgical process to yield in paying quantities. This was the time of small operations and crude processes. The producer was to little expense for his raw material and labor, and had no thought of nor use for the thousand and one essentials and accessories to trade which now are nearly universal in use and application.

Until comparatively recent times old and long established firms have often held their place in the field of commercial supremacy, because of the fact that they *were* established and had honorable and successful

records to back them up. So fortified, they were enabled to meet all comers in their particular field, asking and obtaining better prices than their less experienced rivals. This can hardly be said to be true at the present time. No sooner does a field show a large profit than the promoter, aided by capital wanting investment, steps in and, guided by the cumulative experience of others, directed by the best managerial talent to be had, and taking care of its business by a system practically perfect, the new venturer in the commercial arena often bests its older rival. This competition, of course, results in a substantial reduction of prices, particularly if the old selling price was high because of monopoly, rather than because of technical knowledge and skill required in its manufacture and sale.

The "Established" Firm Versus the Competitor

Recent times, too, have seen the development of the trust. The liberty allowed under the corporation laws of various states has been taken full advantage of by many industrial organizations, and these combinations are often so arranged that the real profit of twenty-five per cent or larger is so distributed by means of stock judiciously "watered," that the shareholder not on the inside, comes in for only a modest five or six per cent. This requires, then, in order that the overcapitalized organization may bear the imposed burden of dividends on watered stock, that the production cost be reduced to the lowest possible figure.

The Trust as Related to Low Productive Costs

These three causes—appreciation in value of natural resources, growth of competition, and rise of the trusts—have been the important factors in developing the science of costs in America.

The older countries, however, restricted in their natural resources, having competition highly developed for decades and accustomed to perfected organizations somewhat similar to the modern trust, have given the science of costs more study than the younger and more wasteful nations. As early as 1832, Charles Babbage, A. M., professor of mathematics in the University of Cambridge, England, issued a comprehensive volume of 282 duodecimo pages under the title, "On the Economy of Machinery and Manufactures." Several of the thirty-two chapters of the book relate directly to the science of costs, Chapter XX, "On the Separate Cost of Each Process in a Manufacture," reading in part as follows:

"The great competition introduced by machinery, and the application of the principle of the subdivision of labor, render it continually necessary for each producer to be on the watch, to discover improved methods by which the cost of the article he manufactures may be reduced; and, with this in view, it is of great importance to know the precise expense of every process, as well as of the wear and tear of the machinery which is due to it. The same information is desirable for others, through whose hands the manufactured goods are distributed; because it enables them to give reason-

able answers or explanations to the objections of inquirers, and also affords them a better chance of suggesting to the manufacturer changes in the fashion of his goods, which may be more suitable either to the tastes or to the finances of his customers. To the statesman such knowledge is still more important; as without it he must trust entirely to others, and can form no judgment worthy of confidence, of the effect any tax may produce, or of the injury the manufacturer or the country may suffer by its imposition.

"One of the first advantages which suggests itself as likely to arise from a correct analysis of the expense of the several processes of any manufacture, is the indication which it furnishes of the course in which improvement should be directed. If any method should be contrived of diminishing by one-fourth the time required for fixing on the heads of the pins, the expense of making them would be reduced about thirteen per cent, whilst a reduction of one-half the time employed in spinning the coil of wire out of which the heads are cut, would scarcely make any sensible difference in the cost of manufacture of the whole article. It is, therefore, obvious that the attention would be much more advantageously directed to shortening the former than the latter process."

This writer was far in advance of the time in which he lived, as the foregoing paragraphs will bear witness, and when it is considered that he entered minutely into many questions now important ones,

anticipating problems of the present day, the importance of his work may be better judged.

Growth of the Science of Costs

It may be safely said, however, that not until the 80's was the science of costs considered of sufficient weight in the administration and record of manufacturing, to be taken up by either America or the older countries. That decade saw several books on the subject issue and a relatively small per cent of older manufactories install simple systems. From 1890 to the present time, costs and cost systems have been studied, tried and improved upon and the present year sees an interest taken in the science proportionate to its importance. It is safe to predict that an exact appreciation of the true importance of costs will not be long in pervading all branches of business to which it may be profitably applied. Manufacturers are not only awake to the importance of cost-knowing, but are generally instituting systems of cost determining and recording.

The present status of costs in industry is an anomalous one. The manufacturer is anxious to know his costs, but he has not yet the faith in the accuracy of cost accounting methods. He hates to run by schedule while his competitor runs "wild." This is due partly to the idea that cost finding is a mysterious process, not readily comprehended by the ordinary business man and partly to the fact that competent cost keepers—men understanding the various ramifications of business into which cost finding runs—are

hard to find. Only the employer who has to put up with indifferent help, thoroughly realizes what this means. With the scarcity of really competent employés in older branches of industry, a new field is liable to invasion by those manifestly incompetent, who rely on a complicated lot of data and a strong bluff to pull them through. It is a fair assumption that the subject of costs is as difficult as stenographic work, and the business man of even limited experience knows the difficulty of securing from among the thousands claiming a knowledge of the art, one who is really competent; this, too, in view of the fact that the employer is competent to judge immediately of the qualifications of the employé and to secure a successor at once. Only a long and thorough trial may reveal the incompetency of a cost system or the employé in charge of it.

Scarcity of the Really Competent Employé

The status of costs today sometimes is comparable to the condition of various lines of machine trade a decade ago. Ten years ago a man selling electrical coal mining machinery, stood to lose anywhere along the line. First, he must overcome the prejudices of the company buyer, the mine foreman, and to some extent the men, before getting his system in. Second, he must teach those who were to handle the machinery, the methods of work. Third, he must judge accurately the working conditions and map out the way ahead for the installed system to continue to show actual results as well as

Installation of a Cost System

latent potentialities. Now, let the same man go into a mine fitted out by him some years ago and he finds that in some cases his system has marched by him, it has been so adapted to the surrounding conditions that many of the under employés can give him pointers as to its efficacy. Because of the better grasp of the man of administration to-day, the cost expert installing a system would find introduction much easier, but the remaining conditions enumerated above often are much the same.

Costs to be of use must be nearer accuracy than most any other result demanded in business administration. If costs—the cornerstone of the business fabric—is out of true the whole superstructure is liable to totter and fall under the strain of systematic competition. Speaking of this phase of business organization, Alexander H. Revell says:

"A cardinal weakness in most factory systems is a failure to get at the cost of production with sufficient accuracy. Every article, book or document that will in any manner throw light upon this difficult problem should be eagerly sought by the progressive manufacturer. He can afford to neglect nothing which will aid in the accuracy and ease with which his cost of production is to be determined. Here is a matter in which guesswork will not do, and where a fraction of a cent, in the ultimate findings, is of serious moment."

CHAPTER III

ELEMENTS OF THE SCIENCE OF COSTS

The science of costs is not an exact one, for the reason that the items in many cases are and can be merely estimates, and as such are subject to error. True, a system of costs may be devised and worked so as to be satisfactory to all concerned, but there is not, nor can there be, any standard system, nor one that can secure a certain set of figures of which may be said: "This is the *exact* cost of a unit of manufactured product." Take the item depreciation—treated in detail in a succeeding chapter—few authorities agree as to what is the annual depreciation on machine tools under precisely similar circumstances. Assuming that depreciation charges were absolute, who can foresee the invention of a machine which renders a certain machine tool worthless—which immediately depreciates its value to that of scrap? Yet depreciation must enter into every cost, and as an unknown factor of the whole result makes the entire science of costs an inexact one.

Costs not an Exact Science

The underlying principles of the science of costs, however, are not only exact but surprisingly simple. It is only when it comes to the application of these principles that confusion results.

There may be few or many elements entering into

the cost of a product. The savage who, unaided by even the simplest tools, takes the gold from the auriferous bank of a stream, has to do with but one element in the cost of production—that of labor.

This may be represented as follows:

$$\text{Cost} = \text{Labor}$$

Supposing the same savage wished to construct a teepee, but did not have the skins and poles necessary. He buys everything necessary, erecting the structure himself. Cost to produce here becomes Material + Labor, or

$$\text{Cost} \begin{cases} \text{Material} \\ \text{Labor} \end{cases}$$

Here Material means that which is used in the manufacture of an industrial product.

Now, if the savage spends his time, instead of at the chase, in his hut making articles of use or ornament, using tools necessary in such production, he becomes the prototype of the manufacturer of the present day. Cost to produce—later called Factory Cost—has now become, Material + Labor + Burden, or

$$\text{Cost} \begin{cases} \text{Material} \\ \text{Labor} \\ \text{Burden} \end{cases}$$

Burden, as here used, means the expense of all appliances necessary, including rent. Commercially, it includes more, as will be treated later on.

It is with the introduction of this factor, Burden, that the science of costs becomes a complicated one.

Burden the Element Which Complicates Costs

As long as material and labor were the only elements entering into the product it was possible to determine to exactness the cost. In the example just given Burden would be made up of practically one item, depreciation of the hut and tools in which the savage performed his work. If the work was of a class requiring the use of light and heat also, Burden would be thus represented:

Burden { Depreciation of (a) house; (b) tools
Heat
Light

A clear understanding of the three items, Material, Labor, and Burden, constitute the whole of the science of production costs, in the restricted use of the term. Production and selling are distinct sciences, requiring the application of entirely different talents. Restrictedly, therefore, production cost or cost to produce does not comprehend or take account of the cost of selling. Practically, selling expense is one of the most important factors in the science of costs. Often an entire product would be useless were it not for the selling department and consequent selling expense. When this factor, Selling Expense, is added to production cost it gives "Cost to Make and Sell," as follows: Production Cost + Selling Expense = Cost to Make and Sell, or

Cost to Make and Sell { I. Production (Factory) Cost { Material, Labor, Burden
II. Selling Expense

When a product is to be disposed of, to the cost of making and selling must be added the final factor, Profit, for without equitable profit the business can not continue. This brings the selling price: Cost to Make and Sell + Profit = Selling Price, or

- Selling Price
  - I. Cost to Make and Sell
    - 1. Factory Cost
      - (a) Material
      - (b) Labor
      - (c) Burden
    - 2. Selling Expense
  - II. Profit

The foregoing outline is as complete as need be made before going further, with one exception, which is this: Above, Factory Cost is divided into three equal elements, Material, Labor, and Burden. Labor + Material has been used by the older writers on costs to mean Prime Cost. Labor as so used, is restricted in meaning to the wages of those operatives whose time is so spent that it can be reckoned for charge against the individual article or articles made. A common, though less exact conception of Direct Labor, is, that class of labor which actually produces in part or whole the made or manufactured article. Direct Labor is also called, Productive Labor and Non-diffused Labor, the former term being a common one, all being synonymous. The operative who makes a casting for a machine; the one who polishes it and fits it into place; the mechanic who finally adjusts the entire mechanism before the machine is put out—the work of each falls within the division Direct Labor.

The Elements Prime Cost and Direct Labor

Opposed to Direct Labor we have Indirect Labor, also termed Non-productive Labor (this being a very common designation), or Diffused Labor. Indirect Labor is that labor which, by reason of its general effect, can not be reckoned for charge against the individual article or articles made. Indirect Labor, like Direct Labor, has a more common but less exact definition, when stated to be "that class of labor which does not actually produce in part or whole the made or manufactured article." Perhaps the best illustration of Non-productive Labor is that of the supervising foreman, who merely oversees his workmen.

Taking, therefore, the division as held to by the older authorities on the subject, Factory Cost is thus resolved into its elements:

Factory Cost { I. Prime Cost { 1. Material; 2. Direct Labor } II. Burden }

This seems to be the logical division and the one to which many competent authorities lend their sanction. Prime Cost means first cost. It can mean nothing else, and the first cost is simply the cost of the material used in the actual making plus the cost of the labor necessary to produce the article made. The reader of contemporaneous literature on costs will be saved considerable trouble by remembering that engineering literature commonly uses the term in the above sense, while writers treating the subject from an accounting standpoint often lump in the factor Burden or some

part of it. It is to be regretted that this discrepancy in the use of the term Prime Cost exists, as the inclusion or exclusion of Burden in Prime Cost is an arbitrary one. Prime Cost is synonymous with the term Book Cost, used by late authorities.

In its broad sense, Burden is collectively such charges as are accessory to the making or manufacture of a product not including the Direct Labor or Material entering into it.

The science of costs intermeshes with numerous phases of industrial economy, but has to do principally with three divisions: (1) Factory organization; (2) factory management; (3) factory records.

Relation of Costs to Factory Organization

There is but one right way to produce a given thing, and it lies within the scope of factory organization to perfect the plans by which a given product may be produced at a minimum of labor and expense. This requires the exercise of the highest faculties of the human brain. As a basis from which to work, intimate knowledge of the various processes through which the raw material must pass before finally becoming the finished product, must be had; combined with this must be an exact knowledge of the industrial advantages and disadvantages of location, both as regards the factory itself and its component parts; lighting, heat, and ventilation must be studied that the operatives may work to the best advantage; areas must be carefully considered so as to afford sufficient room for growth without re-

modeling, and limitless other questions of scarce less importance must be decided before a single nail can be driven or a stone raised. All this lies within the province of the engineer. Engineering might, in fact, be defined as the science of economical production.

Costs and the Engineer

The relation of the science of costs to the engineer is therefore an intimate one, and one to which the future engineering curriculum will pay close attention. The engineer is peculiarly fitted to deal with costs for the reason that he is used to dealing with inexact data, from them obtaining the most exact deductions. Working at all times mindful of a margin of error and having a precise and first-hand knowledge of basic principles, he is competent to approach the subject of costs from a broad plane, solving doubtful cases by the exercise of common sense rather than by slavish conformity to rule.

The factory having been erected and ready to run, its future lies with the factory manager. The one talent the manager of a business can worst do without is business shrewdness. He may have trade and process knowledge and know the business he controls from inception to close, but if he has not or can not acquire the indescribable sixth sense, shrewdness in business, he might as well shut up shop at once, for it will be only by the means of remarkable good luck, combined with a train of favorable circumstances that he will be enabled to stay in business at all. Now, what has this

to do with costs? Only this: Every shrewd business man has an exact—though often intuitive—knowledge of costs. Just as we see artists who paint without instruction and apparently without method, because of an inherent knowledge of art, so we find those men who require no complicated process of cost determining for their own information, as they have the skill to dispose of their product at a price above the danger line. They know the danger line of low prices is there, and are able to sense the approach to it, and by turning every energy, more to an increase of income than to a radical reduction of costs, they are able to do a constantly prosperous business.

Business Shrewdness and a Knowledge of Costs

Upon the manager devolves the manifold duties of the superintendence of the factory, and his success is intimately connected with his knowledge of costs; generally, a knowledge of costs in his particular line and in related lines; specifically, a knowledge of the cost of his product as turned out by his factory. Knowing both these factors, the base for success is laid. It is the function of one of the departments of a business to record the financial transactions as they occur. This comes in the province of the bookkeeper. If such work is of high grade and of more than ordinary importance, bookkeeping becomes accountancy, and the bookkeeper, an accountant. Cost *determining* does not lie within the scope of either bookkeeping or accounting. Cost *recording* does.

Relation of Costs to the Bookkeeper or Accountant

The accurate determination of costs requires the technical knowledge of the engineer, or the practical knowledege of the business manager, or both, combined perhaps with more or less knowledge of bookkeeping. The various costs having been determined, the bookkeeper sets them down, using for his record those forms which experience and study have shown him to be the best adapted to the task in hand.

An excellent foreign work on the subject of cost accounting treats the subject of Depreciation at length and then states that the application of the principles set down does not lie within the subject of accounts, but,

"However, is a matter to be settled by the proprietor himself and must largely depend upon existing conditions."

Inaccuracy in the Use of the Term "Cost Accounting"

In order to avoid the inaccuracy of the term cost accounting, the distinctive terms "cost determining" and "cost recording" are used in this work. Cost determining is the finding of such data as is necessary in the economical administration of business affairs; cost recording is the work necessary in placing in required form the data so determined. The term "cost accounting" has been used by writers to have a variety of meanings, by some to comprehend the entire science of costs, which, as before said, lies without the scope of accounting; by others, to include merely cost recording. Owing to the true, restricted meaning of the term, "cost accounting,"

and the looseness with which it is employed in literature, in this work the terms "science of costs," "cost determining," and "cost recording" are used with exactness to mean, the entire range of the subject, the finding of cost data and the recording of cost data, respectively.

The science of costs is intimately related to the department of sales. Below the line of demarcation which separates profit from loss there is no going, in a well-managed business. In a credit business it can not be even approached, for the percentage allowed bad debts must be always reckoned with. Price-making, as a usual thing does not devolve upon the salesman. He is bound hard and fast to his list. But a knowledge of costs gives him a basis from which to do intelligent work. Knowing accurately the margin of profit he is in a position to push constantly for profit-yielding trade. In making an emergency cut for trade, he will not fall into the error of reducing prices so low that he will be subjected to the humiliation of having the order cancelled by the house. Were his competitior, too, guided by accurate costs, the work of every salesman in the field would be easier, for all would be working from relatively the same base, cost of product, instead of empirically from the sales list.

Relation of Costs to the Salesman

The science of costs is also intimately related to another important department, the department of buying. The manager often is, and by virtue of his position

should be, the buyer for his factory. But this is often impracticable. He may not have the time or the technical knowledge necessary. Here a knowledge of costs insures intelligent work. An example of this is illustrated by an incident taking place within the year. A firm which has built up a large trade in stoves contracted, at a substantial salary, with a traveler who knew the stove business from its inception, being particularly well informed on costs. To him was entrusted the buying for the house. As a direct result he saved the firm his salary for one year before he ever sold a bill of goods.

Relation of Costs to the Buyer

It is not possible, of course, for a buyer of a diversified line to have as accurate knowledge of processes and costs as a specialist, but a considerable knowledge can and should be acquired, if a buyer wishes to render his employer the best possible service.

CHAPTER IV

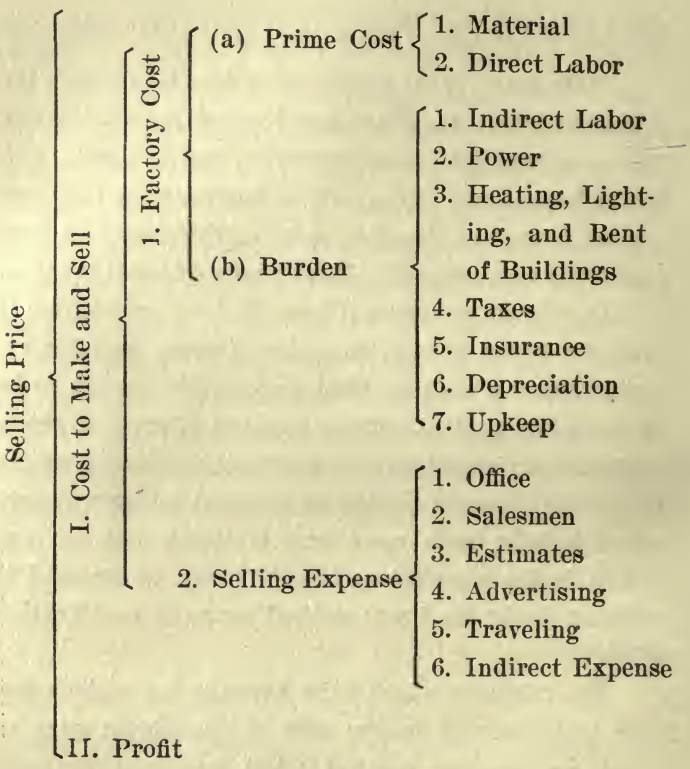
SELLING PRICE—THE FACTORS COMPOSING IT

If the study of the science of costs is begun with the lowest elements to which the highest factor—Selling Price—is reducible, such treatment, it would seem, will be the logical one. This is true because such elements are introduced in the same order as that in which they are used in manufacture and are charged in cost keeping.

In providing a general formula for a proposition it must be broad enough to embrace every possible example under a common head and specific enough to be of use when applied. Many methods of graphic representation are empolyed to convey to the mind in logical order, the elements making up a complex whole. These methods have each more or less merit, but the one which is the simplest and most easily understood is without doubt the brace method, or some modification of it.

The relations which exist between the various factors and elements in the cost of production vary so much in size and amount when measured by some standard, that the brace method, besides being as simple, possesses the advantage of being applicable to any business or manufacturing plant, where productive costs are determined. Careful reference to the following table will be of great help.

A representation of this method of showing the elements making up Selling Price is here shown:



Selling Price is made up of the simple factor Profit and the complex factor Cost to Make and Sell. The selling price of an article or product is the cost to the consumer (disregarding freight or like charges). It is the objective point of a system of costs to make the

selling price as low or lower than that of competitors, and still keep the factor Profit as large as possible.

Profit is the return from the employment of capital after all charges for labor, material, interest, depreciation, selling expense, and other expenses of the business have been deducted. It is the difference between Selling Price and Cost to Make and Sell.

A misapprehension of the meaning of "profit" is responsible for a large percentage of the failures in business. This is nowhere better shown than in certain country stores. One who has sold the country trade or met the individuals comprising the storekeepers of the smaller country towns knows how common it is to take the difference between the buying price of an article and its selling price, and call that difference "profit."

Cost to Make and Sell—often called Final Cost or Cost—is made up of two complex factors, Factory Cost and Selling Expense. Selling Expense comprehends every expense related to or connected with the disposal of a product. In a machine, the following items are comprehended under the head Selling Expense:

Selling Expense
- Office
- Salesmen
- Estimating: (a) Ordinary; (b) Drawing Room
- Advertising
- Traveling
- Indirect

These elements will be taken up in detail later.

Factory Cost is made up of Prime Cost and Burden. Burden has already been defined, and may be subdivided as follows:

Burden
- Indirect Labor
- Heating, Lighting, and Rent of Buildings
- Taxes
- Insurance
- Depreciation
- Upkeep

Prime Cost, as has been taken up before, is made up of two simple elements, Direct Labor and Material. While Direct Labor is a prime factor, yet it is sometimes in machinery manufacture divided into classes as follows:

Direct Labor
- Machine Shop Labor
- Foundry Labor
- Drawing Room Labor

This division is the last element derived in the separation of Selling Price into its component parts. It will be noticed that a regular gradation exists in this scale. In the descending scale from Selling Price to Direct Labor the first element of division is always a complex one, subdividing until unity is reached, while the second element is either simple or simply complex. This, of course, is of passing interest only, but helps to fix the outline of the science in the mind of the reader.

The preceding outlines show the diagrammatic relations existing between the various elements and factors

of costs, as commonly accepted by the best authorities to-day. The inexact use of terms by different writers is more common than material differences in graphic representation, though occasionally both tend to complicate the subject.

The various elements of the science of costs having been defined and graphically represented, each element, beginning with Direct Labor, will be exhaustively treated in the order of its introduction as an element into the final cost to the buyer.

CHAPTER V

MATERIAL

Material is the first great factor in the cost of a thing to the producer—the other items being Labor and Burden.

That which is used in the manufacture of an industrial product, entering into and becoming a part of it, is termed Material.

The first prime cost of any manufactured product is the outlay for material. The science of costs, therefore, furnishes a monetary history of the progress of the raw material from the time of its purchase, through its transformation, to its completion as a finished product. In the ordinary business this history commences with the purchase of the raw material and ends only with the selling price. Theoretically Cost to Make and Sell is the real objective point, but it is the best system which stops only with the final price, showing every gradation between.

Material may be classified as follows:

Material { Raw Material
Finished Commodity
Accessory Material

Raw Material is entirely a relative term, and may be defined as any material for use in a process before it has been subjected to that process. The definition of

raw material given by H. C. Carey is as true to-day as it was fifty years ago. Mr. Carey says in his Manual of Social Science: "What, however, *is* raw material?

Definition

In answer to this question, we may say, that all the products of the earth are in turn, finished commodity and raw material. Coal and ore are the finished commodity of the miner, but the raw material of pig-iron. The latter is the finished commodity of the smelter, yet only the raw material of the puddler, and of him who rolls the bar. The bar, again, is the raw material of sheet-iron, that, in turn, becoming the raw material of the nail and the spike. These in time, become the raw material of the house, in the diminished cost of which are concentrated all the changes in the various stages of passage from the crude ore lying useless in the earth, to the nail and spike, the hammer and saw, used in the construction of a dwelling."

In the science of costs the term Finished Commodity designates any industrial product which is introduced, without substantial change, into the composition of another product, usually as an accessory part.

As an example, a firm manufacturing cement mixers finds the demands of the trade require that motive power be furnished with nearly every mixer. They manufacture the mixer and place it in the warehouse, it then being, as far as they are concerned, a finished commodity. If, when the mixer is sold, an electric motor is mounted and shipped with the ma-

chine, such motor is a finished commodity entering into the make-up of the machine, it not having been processed into shape as has the iron and steel which go to make up the remainder of the cement-mixing machine.

Accessory Material is material necessary to a process, yet not actually entering into the completed product, as a scaffold built around a machine when assembling it, and is commonly considered a part of general manufacturing expense, particularly if the material is used again and again, and not directly chargeable against a particular job.

The matter of the finding and apportionment of the cost of material is a simple one and may be arrived at with comparative exactness. Material is affected by the daily fluctuations of the market, it is true, but even then a mean price is easily determinable. Many factories contract for a year's supply of a product at a fixed price, so that market fluctuations do not have any effect on the keeping of costs. For instance, a company using several thousands of tons of castings per year, contract for them at a uniform rate per pound, delivered. The total weight of castings entering into a machine times the price paid per pound, obviously gives the cost of the cast iron for that machine.

Value of Material

The steps in the treatment of material are as follows: (1) Purchase; (2) storage; (3) use; (4) record (of all preceding acts affecting it).

In the present system of factory organization the

manager is the one from whom all purchases issue; he is the nominal purchaser. As has been mentioned on a preceding page, this power may be vested in a specialist or in a number of specialists, who have more skill in buying and time in which to exercise that function than the manager.

Purchased material either goes direct to the store room or is kept track of by the storekeeper, who should be able to show by his records the receipt of material, issue of material, and balance on hand.

Cost of Material may be subdivided as follows:

Cost of Material
- Material
- Freight
- Express
- Drayage

The elements of Freight, Express or Drayage are constituents of Cost of Material. In figuring on material the cost at the factory is first taken, to it is added the cost of laying down the material at the factory door. There may be either freight or express charges and also drayage charges at one or both ends of the line.

Transportation charges of whatever kind on raw material, should be so distributed as to be borne proportionately by the material incurring the expense. If they are not and Freight, Express and Drayage are made general charges, a machine may be put out bearing a disproportionate burden of such charges wrongly placed.

By stores is meant those supplies including raw

material kept on hand for use in a business. While the stores account primarily concerns itself with the raw material used in a business, it often comprehends merchandise chargeable, not as Raw Material but as Burden.

The matter of supervision of stores depends upon their amount and value. Where the material used consists mainly of pig iron or heavy castings, there would be no supervision necessary to prevent loss by theft. Where a miscellaneous lot of finished and valuable product is kept among the stores, an exact system showing the disposal of every piece should be kept, not only for use in cost calculations but as a check on petty thieving. Brass castings and copper material are particularly liable to this form of "leakage."

Supervision of Stores

Stores in bulk are liable to a fixed percentage of loss. This loss is ascertainable by experience and should be considered—if the percentage is appreciable—in store room and cost calculations.

Material once received by the store room can not issue without authority. This authority may be vested in the manager or foremen of various departments or any intermediate employé.

The duties of the storekeeper are to receive incoming goods, verifying same by invoice, fill such requisitions for stock as are duly authorized and keep such account of stores as is deemed necessary to proper business administration. For this a stores ledger may be

used, being simply a ledger in which required accounts are opened, keeping a record of incoming and outgoing stores.

The old stores ledger is fast being superseded by some form of card system. The efficacy of card systems as a means of saving time and expense is well recognized so the numerous advantages will not be enumerated here.

One of the functions of cost ledger accounts is the charge of each job with the material used, exhibiting both quantity and value. In case a product is made in uniform lots, an estimate may be made of the material used in a standard product or machine and the job charged with a proportionate amount according to the number manufactured.

Fluctuation in Price of Material

An attempt to follow material through a job with regard to ordinary fluctuation in market price is not practical. There are several methods in use to determine a fixed price of raw material to be used in a machine. One is to take the buying price and consider it final, the reason for this being given that the buying price is the price that concerns the manufacturer. Another method is to take the average or mean price for a term of years and call such price the market value. The argument advanced for this method is that a machine in process of construction may market at a time when the raw material of which it is composed is either higher or lower than the buying price, and in order to estimate

correctly the price of the component parts of the machine, a mean average price must be taken.

Inflation of assets in business must be guarded against, even in the case of material. Such inflation can occur by writing up the value of material in the storeroom or in process of manufacture, before the finished product is actually sold, or by assuming the market value of raw material to be its original cost with the addition of transportation charges. Transportaion charges may or may not enhance the market value of raw material. The factory location may be such that the market value of the material would not equal the cost of removal.

An apparent profit to a factory may be shown by the general factory buying from a branch at a certain per cent above cost instead of debiting to Manufactured Stock at cost. This may be advisable in a few individual cases, but as a practice, is liable to be a misleading one.

In a works having several branches each maintaining a separate stores department, the following outline of procedure is one followed by advantage by many.

The head of each department makes a requisition to the head office for all stores needed in his division. This requisition issues on a stated date, as on the 25th of the month, on the 1st and 15th, weekly, or oftener. Stores are not allowed to get beyond a certain point, but if an unexpected demand does reduce them an

emergency requisition is issued. All requisitions are turned in far enough ahead to allow time for purchase by the head stores office, in case they are low.

Requisition forms may be as simple or explicit as the needs of the record require, but usually exhibit:

Requisition for Stores

(1) Description of the material or article; (2) quantity; (3) for use in———; (4) when needed; last supply obtained———; (5) by whom supplied; (6) remarks. Such requisition may be made out in duplicate or triplicate, and the carbon copy may be checked up with the goods when received. These goods are usually invoiced separately to each department of the works, as delay and confusion may result from the sending of one invoice from department to department for the checking off and verification of stores received. Should the checking be done at the head office, one invoice is enough as the storekeeper, on receipt of the goods, checks same off with his duplicate, and if found correct, sends the requisition number with his O. K. to the head office. Should goods not be as ordered or otherwise unsatisfactory, the requisition number is forwarded with notation of rejection. In case the storekeeper has made out his requisition in triplicate, the first sheet will be the "Original," the second, the "Advice," the third the "Voucher." In this case the Advice would be forwarded to the head office bearing checks and notation, such annotations having been duplicated on the Voucher by carbon paper. This gives the head office a receipt from

the storekeeper, the Advice being attached to the Original as a receipt, and the storekeeper has in his hands the Voucher, which embraces the history of the requisition from the time it is made out until the goods were received by him.

If a stores invoice book is kept, the invoice of goods when received and verified will be entered therein, showing the amount of invoice as received, and the amount of invoice as verified, which amount is posted as a credit to the individual firms, and as a debit to the commercial ledger under General Stores. If these amounts are to be analyzed and used as a check on the departmental stores account, the ledger is so ruled as to permit each department or works to have a separate column. This also aids in the tracing of errors made in keeping of the different works books.

Should a stores received book be kept it will contain the information of the requisition "Advice," and the stores ledger folio. From this is posted in the stores ledger a debit to the specified material account.

The stores departmental ledger closely resembles the commercial ledger. Instead of the accounts being with individuals they are with specified materials. Space is provided for such information as necessary, as description, rate and amount of goods. In addition, the debit side should have a space for the firm name of the house supplying the stores.

Orders for stores are made out in duplicate by the one authorized—usually the foreman or departmental

manager, the original going to the storekeeper, the duplicate being retained by the one ordering. When issued, the stores are receipted for on the original order, which becomes a voucher for their issue. The stores order may be as explicit as desired, usually exhibiting in detail the contemplated disposal of the stores, whether called for in the regular process of manufacture, for works order No. —, for maintenance of plant, or for other purposes.

Diverted Stores

In case stores ordered and supplied are diverted from their original purpose, the one ordering such stores gives a detailed notification to the storekeeper that he may credit the debited account, and place the debit where it properly belongs. This may occur on a special or rush order, when the machines use the material already at hand for another order, and if not properly reported will show a low material record for the rush or special job and a correspondingly high material record for the job from which the material was taken. This, too, is liable to happen where stores are ordered in excess of need for jobs, or where an estimate has allowed for more material than is needed. The rule should be that surplus of any kind should be returned to the storeroom, as well as diverted material reported for proper charge.

Scrap reported from a job may be treated in various ways. A satisfactory way is as follows: When a large amount of scrap is handled it may be considered

in bulk and pro rated to the material from which it came. Such credit would be the amount which the scrap brought on sale. If not sold but held for sale, a fair price would be taken, being the mean market price. If returned to the works for remelting or other use it would be considered worth the scrap price, plus the charges necessary to lay it down for use at the factory.

In concluding the chapter on Material, it may be said that the question of interest to the manufacturer is, whether or not his business is large enough to demand an accurate record of stores. It would seem that it is no more advisable to leave stores about without a check, than it would be to leave money lying about loose, and subject to no record. Stores are not only liable to misappropriation, but to misuse and depreciation, and should be subjected to as careful supervision in their purchase, issue, and use as every department of factory expenditure.

CHAPTER VI

LABOR

The greatest cost of production is labor, and the more complex the product the greater is this cost.

Price Considered as Cumulative Labor Cost

The first cost of anything is its labor cost, and the cost of a thing at the present time is, from one point of view, the cumulative cost of the labor spent to produce that thing from the raw material. Every manufactured product existing to-day was at one time raw material and only by the exercise of labor has it become what it now is. On a preceding page has been given an illustration of the savage picking up native gold from the bank of a river at the sole cost of labor. When he desires anything, it is to be had at the direct or indirect expense of labor. Labor cost first enters into the price he has to pay for everything, and as all values spring from labor, burden charges can not arise until labor has purchased that which bears the burden.

While methods of hiring labor and keeping a record of the individual employé may be said to fall within the subject of factory organization and management and without the science of costs, yet a correct record of labor necessary in costs, can not be kept without a minute record of the employé. There are employers who require a detailed application blank, with informa-

tion sworn to, with vouchers signed by one or more persons knowing the employé, this application constituting a part of the employer's records. On the other hand, many factories entrust the hiring, supervision, and discharge of all shop employés to the foreman, who usually keeps no record—or a very imperfect one—of the employés under him.

Inasmuch as direct labor constitutes from forty to fifty per cent of the cost to produce, and is subject to waste the same as any factor of costs, it requires no argument to show that the most complete records should exhibit what disposal is made of every cent paid out for labor. A manager may know that waste is taking place, and only an accurate record will show, for instance, that the cost of assembling is too large, which overcharge may be remedied by a rearrangement of the plan of the factory, if conditions are such that it would be a paying step.

The detailed employé record affects the cost record only indirectly, but at times in a very essential manner. There should be always on file, in an alphabetic card index a complete list of employés, this list to show the following data: (1) Name; (2) department; (3) number; (4) formerly employed by ————; (5) address; (6) engaged by ————; (7) date; (8) occupation; (9) rating.

The foregoing data is self-explanatory, with the exception of division 9, rating, which means more than apparent on the surface. The obvious or nominal

rating should be a colorless one; as, "Recommended by Perry & Schafer;" "Ransom Bros. & Co. say good man," etc., but each indorsement should be merely harmless information and such that when made public or taken in court would not prejudice anyone to whose knowledge such information came. But the employé's number or some other symbol should refer to a private information record kept under the supervision of the manager and seen only by him and a trusted assistant. The employer, to a certain extent, invests his money in his employés, and is entitled to their working history, as a guide, not only to their being engaged, but to their retention, promotion, and subsequent history with the firm. On the other hand, the competent employé, who has taken care to make his working history always a good one, and labored faithfully to maintain a high efficiency record, is entitled to the benefits accruing from such a record. The incompetent, dissipated, or shirking workman is often employed—particularly on a recommend—but his efficiency record will soon show him up and give him only that treatment which is due.

There is no argument needed to show that all real records of this character should be secret, as much damage may be done by even the smallest "leak" in private information of this kind.

The first point to be considered in a system of costs is the accurate recording of the employé's time. The systems used for this purpose are described in detail in Part II of this book. The check or tally system

—now being fast superseded—is one to which many manufacturing plants otherwise modern in equipment, still retain. This system is as follows:

The Tally System Described

The workman enters works through the time office. Each employé has a number by which he is designated, which number he calls out on entering, the timekeeper giving him a check bearing the number called. The works gate is guarded by a turnstile, and once in the workman can not leave without passing through this or some other exit where his leaving would be noticed. This is used as a means to prevent "doubling," as otherwise a workman might call out a confederate's number and secure an extra check, and so lead to an improper credit for an employé not working. If the employés or any of their number leave at noon, the checks are given in at the time office, and again handed them at 12:30 or whenever they return, if the workmen take their noon inside the works, their check would not be turned in until leaving time.

The checks or tallies given out in this system, are racked on hooks numbered to correspond to the tallies. Absence of a check from a hook therefore shows that the employé bearing the corresponding number is at work, and an entry on the time-book or record is made accordingly. Workmen coming late have a "late check" hung on their hook bearing a notation as to time lost, or this notation may be entered at once on the time-record.

The time-record is posted at once and may be verified by the timekeeper, who visits the factory, checking each department for number of workmen, or the foremen may turn in such record, or a combination of both methods may be used.

The check or tally system possesses many disadvantages, but is often retained because of mere inertia, having been installed and worked satisfactorily for a long time it is kept in operation. This system is open to many objections, the principal ones being on the score of economy and accuracy. An automatic recorder of whatever kind dispenses with one or more employés, and is not subject to error, as are personal entries. The various kinds of time recorders are in common use and extensively advertised by the technical press

The various methods of paying the workman have a direct and important bearing on production costs. It is admitted unqualifiedly that all tendencies of the average workman are toward restriction of output. There are two main reasons for this: (1) The wish to receive as much as possible for the least possible work; (2) the theory that work must not be done as quickly as possible as it might throw the worker out of a job, or throw other workers in the same line out of employ, and so tend to a lowering of wages in that particular trade.

The systems of wage payment now in use are the daily wage system or day's-work plan; the piece-work plan; the premium plan, the bonus system, and the profit-sharing system, and various modifications of the

foregoing. A detailed discussion of the relative merits of these plans would be so long as to be without the scope of this work, but the principles of each system will be taken up following—their application depending, of course, upon circumstances. Whatever system reduces the price of labor—increases the output of the employé—is the one to be used and each have their advocates. In many cases it is not the *system* but the *man*. That is to say, an engineer of years' practical experience studies the various conditions surrounding labor as he knows it from personal contact. Being a broad and essentially practical man, he is able to install and operate a system, which, peculiarly fitted to the existing conditions, cuts down expense by a substantial percentage. Another man under different circumstances would make an entire failure of the same system. However, there are underlying principles broad enough on which to build, which, if taken as a basis, form the essentials of a system no matter what the circumstances.

Wage Plans

It is not necessary to trace the causes which have led up to the indifference shown by day workers. There is a minimum inducement only for a day worker to do his best. To do only enough to escape being discharged is more often the aim than to do a just day's work. No matter how often any attempt may be made to equalize men and put them on an equal footing, the fact still remains that a very great difference exists—and always will exist in both the quality and quantity of work done

by different men. Daily wages and equal pay assumes them to be on an equal footing, and such not being the case, is manifestly unfair to some. Either some are underpaid or overpaid, and in either case the remainder are discriminated against.

In the day's-work plan, the employé is paid for the time which he spends upon his work. As a result of this system, an easy-going rate of speed is generally taken, marked by occasional spurts; workmen have little interest in the work, for which the employer overpays. The foregoing facts are admittedly true, and yet the percentage of manufacturing plants employing this plan is large—very large—when compared with what it should be. It is no small undertaking to reorganize a large factory and secure the coöperation of the workers to a successful finish, yet the returns are so great and the experience gained so valuable, that no manufacturer should hesitate to make the change, gradually if necessary, but at any rate, get away from as wasteful a form of production as the day's-work plan of employing labor.

The Day's-Work Plan

The theory of piece-work is a simple one. With the piece-work plan in operation the workman is paid for his work, proportionate to the amount done. A definite price for each job being set, the workman who contrives either by working harder or by the use of better methods to shorten the time of manufacture, consequently earns a proportionately greater amount.

This system, on its face, seems to be based upon

scientific principles and to be fair to both employer and employé. That it does not work well in practice and fails to yield the desired results is evident from an investigation of a large number of shops in which it is or has been employed. Following is an outline of a change from the day's work plan to piece work as it often results in practice.

The employer investigates or can not help observing that his output is not what it should be while paying his help by the day, and a system of payment by the piece is installed. Suppose the labor price of a standard piece of work to be ten dollars. The employer satisfies himself that this piece could be produced for eight dollars labor cost. To give the workman an incentive for faster work, a piece-work price of nine dollars is made, this making in fact, a division of the profitable saving, with the workman. The first objection usually comes from the workman, who fears that he is being taken advantage of, and is certain he can not make wages at the price per piece offered him. Conditions being favorable and perhaps being fortified temporarily by a minimum guarantee, he starts in and increases his output much more than the per cent figured on the job with the result that his earnings increase with such rapidity that the profit to the employer is swallowed up. The logical result is a cut in wages. The employé thereupon figures that too much work done and too large a consequent wage results in a cut. He therefore assures himself

Institution and Workings of the Piece-Work Plan

what is the maximum wage he can receive without a cut, and never increases his output beyond that point. The situation at this point between the employer and the employé is this: The former uses every possible means to increase the output that he may profit by more work without increased burden expense—the men so time their work that they are in no danger of a cut because of large wages. The interests of the employer and the men are diametrically opposed, with the result that the object in view—reduction of cost—is not attained.

Another and important drawback connected with the piece-work plan grows out of the fact that an accurate standard—especially on varied or complicated work is difficult to set. This was shown by Fred W. Taylor, of the American Society of Mechanical Engineers, in a paper presented before that body at Detroit in 1895. Mr. Taylor said:

"Every intelligent workman realizes the importance, to his own interest, in starting on each new job as slowly as possible. There are few foremen or superintendents who have anything but a general idea as to how long it should take to do a piece of work that is new to them. Therefore, before fixing a piece-work price they prefer to have the job done for the first time by the day. They watch the progress of the work as closely as their other duties will permit, and make up their minds how quickly it can be done. It becomes the workman's interest then to go just as slowly as pos-

sible, and still convince his foreman that he is working well.

"The extent to which, even in our largest and best managed establishments, this plan of holding back on the work—'marking time,' or 'soldiering,' as it is called—is carried on by the men, can scarcely be understood by one who has not worked among them. It is by no means uncommon for men to work at the rate of one-third, or even one-quarter, their maximum speed, and still preserve the appearance of working hard. And when a rate has once been fixed on such a false basis, it is easy for the men to nurse successfully 'a soft snap' of this sort through a term of years, earning in the meanwhile just as much wages as they think they can without having the rate cut."

It is plainly evident that the success of piece work depends upon the fairness of the schedule of prices, the subsequent change in those prices and managerial ability of the foreman or supervision of the shop. If the time a job ought to take is accurately figured and the workman is given an equitable price—large enough to be made a real incentive—and a competent management is in charge, the defects of a piece-work system are forestalled or minified and a corresponding saving is effected over day labor.

There are two methods of figuring the probable time on a job. The first is by averaging the time of a number of similar jobs performed under the same con-

ditions. This method presents the advantage, that it actually shows what has been accomplished in the past, and as such is a guide to future production. The disadvantage—and it is held by many to be a great one—is that it is impossible to judge what per cent of the time charged against the job was spent by the employé in "soldiering." It is usual, too, that little or no effort is made to classify the operations necessary to perform the work, and that the result is more or less the nature of a guess—according as past records show a number of jobs similar to the one under consideration or not. A method in successful use is one in which a job is resolved into its component elements, and the quickest time ascertained in which these elementary operations can be performed. These operations can be classified, tabulated and arranged and used as desired in the fixing of rates, and modified as experience shows is necessary. The second method is that of paying no attention to what has been done or what is actually being accomplished and disregarding former practices entirely. The probable time, therefore, must be figured by one who is thoroughly competent to judge of all the conditions, for on him depends the success of the plan. Such knowledge can come only from practical experience and a highly developed sense of the possibilities of labor.

Methods of Figuring Probable Time

In proving that wastes now going on are absurd,

and in direct line with the second method outlined in the paragraph above, Harrington Emerson says in the Railroad Gazette:

"As an example of old practice against new, I hold in my hands the original figures of the skilled and competent engineer of a large shop, who estimated the cost of a certain job at $4,575, of which $3,300 was for materials and $1,275 for labor. The work came under my direction after it was one-third completed, and was pulled off with four men in three months for a total cost of $3,375.09, of which $622.79 for labor, netting a profit of $1,824.91, instead of $629, as estimated—nearly three for one, yet some of the men on that job were paid a bonus [increase] of nearly 100 per cent above their regular wages. I also hold a routing card of one of my assistants, Mr. Parkhurst, in which a car-shop job, marking and moving 200 pieces of oak, was estimated by the foreman to require two days, but was actually completed in two hours twenty-five minutes on a fifty per cent bonus basis."

The system above referred to is a modified piece-work system, known as the differential system, differing from ordinary piece work in that the premium paid is higher—often 100 per cent—and the reward is withheld unless the maximum of production is reached. A more exact definition of the differential rate system of piece work, is that system which pays the employé "a higher price per piece, or per unit, or per job, if the work is done in the shortest possible time, and without

imperfections, than is paid if the work takes a longer time or is imperfectly done."

The premium plan of wage payment is as follows: The workman is paid over and above his usual daily wages, a premium for every hour he succeeds in reducing a previously determined time, such premium being divided between the workman and the employer in a definite ratio. The time used as a standard is determined from previous costs. The effect of this system is to pay the workman for saving time, and has as its basic principle the making of the hourly premium less than the hourly wages.

The Premium Plan

The premium rate is obviously the important part of this system. No hard and fast rule can be laid down as to what premium should be paid, as it would vary greatly with different lines of production, and in the same lines under different circumstances. If a small premium is offered the employé may not put forth the effort necessary to earn it, or if he does, not steadily or systematically. This will defeat the object of the system by not increasing production. If too large a premium be offered, the cost of production will be disproportionally increased. A cut of premium is to be much avoided as in the piece-work plan, as it will lead to the same results. In a perfect working system the earnings of the employé will be limited only by his power of production, and the results to the employer will be an increase of output and decrease of labor cost.

The bonus system of wage paying was first promulgated in 1901. In this system a detailed card is made out showing the various elementary operations making up a piece of work. There is also shown the tools needed and the time necessary for each operation. These times have been previously determined and tabulated as described on a preceding page, there being no operation in the shop not a combination of these elements. The total time allotted on a job of work is obviously the sum of its elementary operations. If a workman is unable to perform his job of work in the allotted time, he is paid at the day rate only; if he performs the work as laid out, according to the specification and within the time limit, he receives in addition to the day rate a definite bonus.

The Bonus System

The instruction cards are and must be made out by one thoroughly familiar with the operations and the records, and as so made they are a guide to the best method by which the work can be done. The ordinary worker, in all probability, would not plan out his work nor would he execute it even approximately as well as he will from his detailed guide card. Continuous working by the right methods tends to make him a better workman and the entire trend of the employé's methods under this system is towards better execution as well as greater output.

The principal advantage of the bonus system over

the ordinary piece-work system lies in the fact that it has a minimum wage and avoids the difficulty found in piece work—that of securing an equitable rate. If proper piece rates could be made, thus avoiding the necessity of a cut, the piece-rate system would be preferable, but such rates are very difficult to determine and often can only be found by "cutting and fitting" until suitable rates are thus obtained.

The difficulties in the way of providing suitable instruction cards are considerable, requiring a vast amount of practical information rarely possessed by one man. As the instruction cards take up processes in detail, if one of the operations is wrongly timed it can be modified as needed, but if any material error is often made it will cause the workmen to doubt the entire system, which result can not fail to be harmful in its result. As a result, the entire success of the plan hinges on the accuracy with which the cards are made out.

The Profit-Sharing Plan

The profit-sharing plan of wage payment is one in which the employé receives a certain percentage of the final business profits in addition to his regular wages. This system is open to many and serious objections, some which are as follows: Anything given the employé under the profit-sharing plan is not in the nature of earning but in the nature of a gift, being in fact, a sum that is in no way earned by him. Profit earned by a company

may be due to the superior management of one man or come from the superior efficiency of the sales force, or from one of a hundred other causes.

Another prime objection is the one urged against the day wage system, viz., that it rewards the lazy employé with the energetic, the poor with the good, as all receive an equal or proportionate share of the profits. Then, too, the rewards are not immediate but remote, and the effect of a future dividend upon any but the most sanguine is questionable.

The workmen must accept on trust, the statement that the dividend is correct. They have no direct means of verifying it, as the means by which the result was obtained is so complicated that few could form any idea as to whether or not the announced profit was just or reduced by judicious "watering" of stock.

The term "profit-sharing" implies a profit. In case a plant were run at a loss, there is no provision for an assessment, and it would be impracticable were there such a provision, as the indirect loss made by assessing the workmen would offset the money collected in. In a term of ten years, it is fair to assume that one or more "lean" years may be met, and under this system there is no provision therefor.

Among the successful methods of getting the employé to take an interest in the business is by making him a stockholder. He then not only "plugs" for the business, but, having a proprietary interest in the company, tries at all times to further their interest both

in the shop or out. The ratio of success by this method may be said to decrease directly with the size of the company, as the smaller the company the greater one man's influence on its future.

In the foregoing discussion of the various wage systems one element has not been touched upon—the relation of burden generally, or depreciation specifically, to output. This will be taken up in the chapter on Depreciation.

CHAPTER VII

BURDEN

The second factor composing Factory Cost is Burden, often called Fixed Charges. This brings in the first inexact factor in the science of costs, and the science is mainly concerned with, (1) Determination of Burden; (2) apportionment of Burden.

As previously shown, the constituent elements of Burden are as follows:

Burden
1. Indirect Labor
2. Heating, Lighting and Rent of Building
3. Taxes
4. Insurance
5. Depreciation
6. Upkeep

The determination of these various elements is not a difficult process and may be arrived at with a fair degree of accuracy—the amounts determined being accurate enough for all practical purposes, the sum of the elements giving the total Burden.

In the apportionment of Burden, the difficulty arises as to how this factor shall be distributed and charged against the made or manufactured product.

If we assume Burden $= b$, and product $= p$, then

$\frac{b}{p}$ = amount Burden borne by unit product.

But p is made up of different and complexly varying factors, and there is not nor can there be any assurance that when p is resolved into those factors that b can be correctly apportioned.

If we take as a concrete example a factory producing 1,000 machines in one month, and assume that each machine goes through exactly the same process, and that the burden for that time was $2,000, then it is an easy matter to determine that the burden that each machine should carry should be $2,000 ÷ 1,000, the number of machines = $2, the amount of burden that each should carry.

But if the conditions remain the same with the exception that the machines turned out are different, each going through an individual process, it is without the scope of practical business possibility to apportion the burden so that it will be borne equitably by each machine.

What can be done is this: Burden may be so apportioned that it is all charged off—each machine bearing some of the expense, as determined by some method of apportionment.

There are three principal methods of apportionment, the percentage burden plan, the hourly burden plan and the machine-rate plan. There are many other methods, for the most part modifications of these, but the two first are in most common use.

Both the percentage burden plan and the hourly burden plan have the warmest advocates, and much

has been written in defense of each system—writers often seeing no other merit in any other plan than the one they set out to defend.

The percentage burden plan is the one usually employed when it is attempted to distribute the indirect burden expense over the work. There is necessary to compute this distribution: (1) Burden; (2) amount expended for direct labor in a given period of time or on a given job. The ratio existing between (1) and (2) gives the percentage by which the direct wages is multiplied, the product giving the burden which that particular work should bear. This is a very simple method, and one that can hardly be called exact. By this method, a shop putting out work uniform or nearly so in product, and having a wage scale not greatly diversified, finds it accurate enough for practical purposes.

The Percentage-Burden Plan

Where this method falls short, however, is in the shop radically differing in conditions from the one noted above. If the working machines vary greatly in identity, the wage scale is not uniform because of varying prices paid labor, and the component parts of the manufactured product are varied in material and price—when these conditions are present, the percentage-burden plan is not accurate enough to meet the requirements of a cost system.

Three of the elements of Burden are Taxes, Insurance and Depreciation. These are chargeable—not against the workman—but against the factory in

which he works and the machine which he runs. But by the percentage burden plan, as part of Burden they are charged against direct labor. That is, a one-dollar man running a thousand-dollar machine is charged only one-fifth as much as a five-dollar man working at a job where the value of the tools may be regarded as ten dollars. (This, of course, is an extreme case and one introduced only by way of illustration.) But the taxes, insurance, and depreciation on the machine used by the one-dollar boy is one hundred times as great as the tools used by the five-dollar man, and the burden is calculated in on the direct labor of each in the ratio of 1:5; when the value of the machine is to the value of the tools as 1000:10 or 100:1.

This and other discrepancies are not taken care of under the percentage plan. When the direct labor is indicated on the time card it stands as the base on which is figured the proportion of the burden it is to bear, regardless of any inconsistencies such as the one above last noted. This makes the calculation an arbitrary one and not one giving a correct solution of the problem of costs.

The Hourly-Burden Plan

The hourly burden plan, instead of distributing the indirect burden expense over the work or the individual job, with direct wages as a measure, distributes this expense over the work according to the number of hours chargeable against such work. In other words, the ratio of the gross burden to the total number direct

labor hours, gives the percentage by which the direct wages is multiplied, the product giving the burden which that particular work should bear.

By use of the hourly-burden plan, Cost to Produce may be entirely different than when figured by the percentage plan. The advocates of the hourly-burden method claim that it is far more logical to take as the basis of calculation the hour instead of the dollar. One of the notable faults of the percentage system, that Factory Cost is always proportional to Prime Cost, is overcome. What in the percentage-burden plan is overlooked—the time spent on a job—is brought to the fore, and the factor Time is considered in its true importance in production cost.

Empiricism is as manifest in the distribution method of the hourly-burden plan as in the percentage-burden plan. The one arbitrarily takes as a base, wages; the other, time. In order to have a system which is simple in operation, accuracy of apportionment is surrendered. What is the result? The system being simple, the conditions to which it is applied must be free from intricacy or complication or inaccuracy results. Whether this inaccuracy is important enough to be essential depends upon the complexity of the facts to which the system is applied. The two are proportional.

If we return to the example of the one-dollar man and the five-dollar man, it will be seen that depreciation and allied charges are no better provided for by taking

time as a base than by taking wages. Either plan is unsatisfactory—and particularly so—when low-priced labor is at work with high-priced machines and high-priced labor with low-priced machines or tools at the bench.

It is not to be hastily assumed, however, that because of inaccuracy in the division of Burden, that the gross cost of a product for a month or year will not be correct. Supposing this gross cost to be figured once a year; obtained by either method, it will be practically correct.

The Machine-Rate Plan

The machine-rate plan is a method ante-dating both the percentage-burden plan and the hourly-burden plan, having its origin before modern methods of accounting and not conformable to them. This plan as most commonly in use, bases on the probable life of the machine under full work, an hourly interest and depreciation charge, this charge to be distributed over the work. By extension, and to provide for the disposal of the remainder of Burden, a part or, rarely, all of the remaining charges are arbitrarily included in this allocation.

When restricted to the factors Interest and Depreciation, and when a machine is running constantly, the machine-rate plan is an accurate one. Inaccuracy results when the machine lies idle.

The advantage of the machine-rate plan and the one which has kept it in use so long a time, is that the

system provides for the inequality of the cost of work turned out on the various classes of machines. The information it furnishes is valuable, but not as complete as might be.

The Scientific Machine-Rate Plan

The scientific machine-rate plan of Mr. A. Hamilton Church is one designed to overcome the various drawbacks of other plans. The shop is divided into various "production centers," such center being a machine or a bench at which a workman is stationed, each station being theoretically a minor shop, bearing its burden of rent, interest, depreciation, etc., independent of other production centers in the same works.

Mr. Church outlines the plan as follows:

"First, we consider each machine as an independent production center, allocating to such centers all the expenses and charges which can, on reasonable analysis, be considerable as chargeable as a composite rent or machine rate for all the factors of production therein concerned. Second, we charge to a monthly shop charges account all charges whatever incurred by that shop, including all the items specifically represented in fractional detail by the machine rates, and also including, of course, such general items as can not be represented in the machine rates, of which the most obvious item is the supervision of a head or foreman.

"Then, as each machine is occupied on jobs, the latter are debited with so much per hour as machine rate, and at the end of the month the total amount so

earned by the machines *is deducted from the total shop expenses,* leaving a balance which is distributed over the same jobs as a supplementary rate. The rates of the supplementary rate to the amount distributed by the machine rates forms a varying barometer, whose fluctuation is an index to the current efficiency of the shop."

Additional distribution is effected in the scientific machine-rate plan by the ordinary hourly-burden method or by a proportionate increase of the machine rate.

Such, in brief, are practically all of the methods in use to-day, for apportioning the burden to the manufactured product. That this apportionment be exact is particularly essential, for the burden seldom represents a smaller sum than direct labor and is often much larger. Burden in itself may represent a sum that bears an important ratio to the capital of the firm, and correct apportionment alone may be responsible for success of the plant, as inaccuracy may be for the failure of the business.

To summarize, it may be said that it is impossible for any hard and fast rule to be laid down as to what plan should be followed in instituting a system of cost accounts. No system should be installed without a thorough comprehension of the organization, management and purpose of the factory. This, of course, lies within the field and scope of the specialist. It is peculiarly in

What System?

keeping with modern ideas that a cost expert can examine the conditions present in a given factory, install a suitable system and so instruct the necessary employés that they can keep the system in active and useful operation.

It is easy to generalize and say that the percentage-burden plan is the safest, particularly where wages form a large part of the cost of production and are comparatively regular in amount; or that the hourly-burden plan with a partial charge for machines in use, is best where output is irregular and cost of labor varied, but it all simmers down to this: As no reputable physician will prescribe for a patient without seeing him and noting all modifying conditions so as to diagnose the case, so no man—no matter how expert he be—can advise the adoption of a certain plan. A factory may lack in its accounting department and have a superior selling force—then it can not use a complicated system. Another and almost similar factory boasts a superior accounting force and the management is a stickler for vouchers and red tape—an exact and complicated system will not fall into bad hands when installed there. And so it goes, the old story, "Modifying Conditions," yet conditions absolutely essential to be reckoned with if a system is to yield satisfactory returns.

CHAPTER VIII

INDIRECT LABOR

Indirect Labor is given as the first element of Burden, and has been defined in Chapter III, in comparison with Direct Labor, to which it is related.

There has always been more or less haggling over the designations, "productive" and "non-productive," as applied to labor, as implying that the epithet "non-productive" designates the worker is an expense—insinuating that he represents an outlay for which there is no adequate return. As an example of this asperity, may be quoted the stock remark of the manager of a western fire insurance company, noted for its habitually strained relations with its agents, because of managerial incompetency. On a special agent turning in a list of appointments, the aforesaid manager would observe, "Too many lawyers in the list—we don't want lawyers—they are non-producers." Himself a flagrant example of a "non-producer," he had no time for them in the agency list.

The Term "Non-Productive"

This allegation that the word carries with it the idea of expense and not production, may or may not be so, as a term may mean one thing to one man and a very different thing to another, because of the differ-

ence in their education, bringing-up, and experience. No such charge can be brought against the use of the term "direct," however, and it possesses the distinct advantage of being more descriptive than "productive," so probably will be used by a majority of writers in the future as it has in the past.

In the use of the term Indirect Labor in the science of costs, it is always to be remembered that it applies only in its limited sense to the labor which is a part of Burden. Indeed a concise and strictly accurate designation would be "Burden-Labor," or that labor only which is a constituent of Burden.

Exclusion of Selling Expense From Burden

To be more explicit: The line of demarcation between Burden and Selling Expense can not be too strictly drawn. The reason—outlined here, and more fully developed later on—is this: Factory Cost is the value of the product as laid down after manufacture in the warehouse. No part or parcel of Selling Expense must be included in Burden or our warehouse value is inflated just that much, and when inventory is taken, that expense shows up in the balance sheet as an asset. For instance, a factory has a Manager and an Assistant Manager. The first man devotes his time exclusively to sales, superintending the selling force and devoting his energies to disposal of the product. Meanwhile the Assistant Manager is in the factory increasing productive capacity. The one takes care of sales, the other looks after output. The first man's expense has nothing

to do with Factory Cost. The factory would run and its output be put in the warehouse—let us suppose—even if there were no sales force. With the second man it is different. His is Indirect Labor, and as such is a part of Factory Cost.

The question naturally arises here, "Is not the labor of the first man as well as the second man, Indirect Labor?" It is, in a generic sense; it is not in a limited sense. Nor need any confusion result therefrom. We have seen that the term "labor" has two meanings, the generic meaning being "work done for the accomplishment of an end," and, restrictedly, "direct labor." Similarly, Indirect Labor has two definitions: (1) Broadly, any labor not direct labor; and (2) restrictedly, any labor a constituent of Burden. So, applying the generic definition to the question above, we have the application that both are in the class of Indirect Labor in sense 1; and only the latter in sense 2.

Viewed from the standpoint of the lexicographer, the terms are not unusually complex, for our most common words have a large number of meanings—the noun "strike" having no less than eighteen separate and distinct definitions.

Indirect Labor Calculation

The calculation of the amount of indirect labor is perhaps the most complicated of any of the items which go to make up the indirect expenses or Burden. The test of Direct or Indirect Labor is not so much on the point of production and non-production as on the point of charge-

ability to some piece of work. For instance, if we suppose that an employé is at work one hour at the manufacture of a dynamo for stock, and is taken off this work to assist in the repair of a motor, working thereat four hours, and later in the day takes a foreman's place for the afternoon, then his time card coming in and showing the foregoing facts, will call for an apportionment as follows: Direct labor on stock order number —, 1 hour; Upkeep of plant, 4 hours; Indirect labor, 5 hours. As a usual thing, the determination of Indirect Labor will not be extremely difficult, but in the case of a large number of "split" time cards coming in it will be detailed work rather than particularly hard.

In case the gross burden is calculated yearly or for some similar period, a daily running account may be kept with Indirect Labor, which will be the amount not otherwise charged to some work or job, the account being treated as though it were a continuous piece of work being totaled when the burden is calculated at the end of the fiscal year or on the taking of inventory. This is liable to reveal the fact that Indirect Labor, when totaled, is a much more considerable amount than might be supposed off-hand.

Here comes up the question of the relation of Indirect Labor to those indirect administration expenses —salaries of officers and directors. When the ways of high finance are considered, it will be seen that no irony is intended when the statement is made that many such salaries should be considered as profit; that

the drawee of a fat salary for which he has given no return, perhaps not even visited the plant of which he is an officer, is merely participating in an irregular division of the profits of the business. At the other extreme we have the manager who has worked his way up from the bottom, and who is not averse to taking a turn in the drawing room or even at the bench, becoming for the time being, an exponent of Direct Labor. Then, too, we may have officers whose work is merely administrative as regards either Selling Expense or Factory Cost, and countless other variations and modifications. Therefore it would seem just that the salaries be charged to such items as are proportionate to the class of work—to Indirect Expenses and Indirect Labor.

This procedure can not but be unsatisfactory unless done with a thorough understanding of the object of the business, and the relation of those participating in its management.

As a discussion of the relation of Direct Labor to Indirect Expense falls within the scope of the latter, the reader is referred to the chapter dealing with that factor.

CHAPTER IX

MINOR BURDEN ELEMENTS

The minor elements of Burden are: (1) Power; (2) Heat; (3) Light; (4) Rent; (5) Taxes; (6) Insurance.

These elements give little or no trouble in calculation of costs.

Power, Heat, and Light are similar as elemental parts of Burden, for each may be purchased outright from a power-, heat-, or lighting-plant, or may be derived from a machine operated as a part of the equipment.

In many cases the fuel account is a large and important one, and one that by reason of its importance can not be handled as a part of the stores. In such cases it is advisable to have a system using a complete fuel register, similar in operation to that described in the chapter on "Material." Fuel is chargeable to Power, Heat, Light, or, rarely, to Accessory Material. Taxes and Insurance offer no difficulty of disposal, either in calculation or allocation. Practically all business insurance is calculated yearly, and rates vary little from year to year. Short term insurance, if on material in the process of manufacture is a part of the factory price, but if manufactured goods are insured in

the warehouse, such insurance becomes a part of the expense of selling.

In the second element, Rent is one about which there is a great deal of disagreement. One extreme view is that the price paid for rented quarters is in the nature of profit: that is, the landlord has invested or supplied a portion of the capital. Rent is the income or profit from this investment. All sums paid for rent eventually come from business earnings. As such, they form no part of factory cost, and add no value whatever to inventory price.

At the other extreme is the view that rent is as much an expenditure as though paid out for any commodity and should be charged in as a part of Burden, whether the company owns the rented building or pays a regular price for their occupancy of it.

The medium ground seems to be the conservative one in the disposal of the factor Rent. If the building is one not owned by the company, then charge rent in Burden. If the building is one owned by the company and because of such ownership represents an investment of their capital, then, there being no rent actually paid, consider same along with interest on investment, as a part of Profit.

The reason for such disposal of Rent seems to be a fair one. If the company has actually invested the capital necessary to buy the buildings, then Rent comes in the same category as Interest, and is disposed of as is Interest, as a part of Profit, because we do not want

to inflate our warehouse cost and so make our goods of more apparent value than they really are. But if the company has no actual investment in the buildings, then, day by day they are paying out for working room a certain sum which is and must be an expense, just as insurance is an expense or heating an expense, and as such, is a part of Burden.

CHAPTER X

DEPRECIATION, UPKEEP, AND RELATED FACTORS

Depreciation is a lessening in value from age and contributory causes. This is a term that is closely related to Upkeep, which is collectively, those alterations, substitutions, or repairs necessary to offset depreciation and keep a plant or any part of a plant in the state required for advantageous work.

Intermeshing loosely with the factor Depreciation is Amortization. Amortization is the extinction or reduction of a debt through a sinking fund. This concerns Depreciation only as Interest concerns it. Interest on the capital of a firm and the deterioration of the buildings, machines, stock, etc., in which this capital is invested are related, but not so clearly but that Depreciation and Upkeep may be considered separate from it, particularly if interest be calculated as a part of and taken care of by Profit.

Related Factors

The determination of Depreciation as a factor in factory management or more restrictedly in the science of costs, is a matter of great importance, and errors in the calculation of this factor render both Factory Cost and Profit inexact. While it sounds like

the repetition of a truism to set down, "no fixed rules can be given for the computation of Depreciation," yet such is the case and practice must conform—as in many other divisions of the science of costs—to the conditions surrounding the business.

Depreciation Studied by Insurers

It is safe to say that the *underlying principles* of Depreciation are more exact, and may be more thoroughly understood than those of many other factors going to make up Cost. For this we have to thank the business of fire insurance directly, though marine insurance takes cognizance of Depreciation, in its restricted field, the valuation of marine risks. Fire insurance, which puts at risk every species of insurable property, concerns itself directly with the state of the risk as regards original and depreciated value at the time of the fire. Consequently this subject has been made a study by underwriters since the time the first risk was written and the first loss occurred, with the result, as before stated, that the principles underlying Depreciation are well marked out and agreed upon.

Depreciation and the Factory Buildings

The present tendency of all well-regulated plants to keep everything repaired up to the highest point of efficiency, often makes Upkeep lower Depreciation very appreciably. This is particularly applicable to factory buildings of late construction. A building having its foundation laid in concrete, its skeleton of steel and cased in brick or concrete blocks, is not only subject to slow deprecia-

tion, but every part in its make-up may be said to be standard and renewable as desired. In this class of buildings an average or aggregate value is maintained. But all factories can not be called well-regulated and it is not with buildings of this class that the cost de-determiner or cost accountant commonly has to deal. Sometimes the factory, by reason of its rapid growth is composed of a series of additions to the original plant and is kept in such a state as is warranted by the fact that "the management intends to build next year." Sometimes the factory is a rented building: other times it is part owned and part rented. In some cases the building itself is neglected because the business is so profitable and requires so much time that there is little time left to make any but those repairs that actually can not be gone without.

The value of a plant and buildings at the outset of business is, of course, 100 per cent and decreases with the passage of time until its value is *nil*.

A Common Method of Depreciation

Perhaps the most common method of reckoning depreciation values is by writing off a certain per cent, as 5 per cent—or such other figure as may be deemed desirable—as the sum to be deducted annually from the depreciated value. The value of the depreciated property then stands at the outset of its second year as 95 per cent of its original value plus the sum expended for its maintenance and upkeep. The principle underlying this method has the merit of being sound, but in practice it

leads to inaccurate results. These inaccuracies come in more from the upkeep of machinery than from the maintenance of buildings. It is no uncommon thing for a machine to be rebuilt after purchase, such rebuilding taking place either immediately after purchase or as the demands of the work call for it. Suppose that, immediately after purchase the gray iron of a machine is replaced by steel and the machine is worked over to suit the ideas of an employé. On inventory the value of this machine will be, original cost less specified per cent of depreciation plus repairs, making it a watered asset.

During the first years of a business the disposition of too large a percentage of the surplus of income over expenditure as Profit instead of a good part apportioned as Depreciation is the cause of the failure of many apparently successful ventures. In the case of a business having a large amount invested in depreciable* property, the tendency to declare some or a large dividend is frequently too strong to be resisted, so a fictitious profit is forced, often for the purpose of inflating the company's stock. Profitable repairs and the required upkeep are both postponed as well, with the result that if new capital is not interested, that stock values sink accordingly, and assessments must be made later to cover necessary charges for Depreciation. Earnings may remain a constant factor meanwhile, and stock

Upkeep Neglected to Swell Dividends

*Depreciable, *a.* Capable of or liable to depreciation;—a new use of the word.

values go up or down as expenditures are made on the plant or not.

In the case of large manufacturing plants, or those having owners very particular about repairs, the outlay for renewals and upkeep may balance the average depreciation of the entire plant. To quote a trite and time-honored saying, it must be borne in mind that a chain is no stronger than its weakest link, and if upkeep is localized, there will come a time when the gradual and hitherto unnoticed lessening of value in parts of the plant not renewed, will manifest itself and call for unexpected expenditures—unexpected because the allowance for the renewal of the plant has always been a liberal one.

Provision for Growth of Plant

Any business able to continue in the field at all, generally is obliged to extend or modify its plant. The reason for this is two-fold; (1) The natural increasing demands of business, the plant being too small to handle the trade; (2) the fact that few firms starting again in business would duplicate their original plans. The American manufacturer and business man is always willing to extend his factory or business if there is a fighting chance of its being made to pay. He is also ready to tear out a building or machine and remodel or replace it with one that will better "do the business." Just when such expenditure is chargeable to Capital and when to Depreciation is not easy to determine. It may be that the management can determine the classi-

fication of such expenditure, but for those not familiar with the object, tendencies, and future of the business, it is practically impossible. When a needed addition is made to a building, it stands, of course, as an expenditure of capital, but such addition may lead to the subsequent abandonment or deterioration of the older part. Many a business is tided over unexpected expenditures or a period of financial depression because extensions and heavy repairs have been taken care of by Revenue instead of Depreciation.

The object of the various methods of calculating Depreciation is to represent the real value of the material part of the plant, by means of depreciative* accounting instead of by revaluation. Greater accuracy might result by periodic revaluation, writing off such loss as these valuations showed, regardless of any regular rate. This would give a more accurate idea of deterioration, particularly if such deterioration were irregular, as from a long period of hard running, alternating with a similar period of comparative idleness.

This method of depreciation reckoning is practical only where the plant and process of manufacture are so simple as to permit its use without considerable trouble. Frequently manufactories are so constituted as to require the application of this method to some of the more important items, the remainder of the plant having the regular depreciation calculated and apportioned without a particularly close examination. Thus a general electrical manufactory may revalue its ma-

*Depreciative, *a.* Of, relating to, or designating depreciation.

chine tools costing $500 or above, every year or six months, and write off a certain per cent for the rest of the plant.

Periodic Valuation

The plan of periodic valuation instead of that of the regular depreciation rate, while theoretically more nearly perfect, is subject to some drawbacks. Under the first plan the basis of appraisal is generally the two following facts: (1) Condition of the property at the time of its examination; (2) earning capacity. Taking these facts as a premise may lead to a wrong conclusion, as deterioration may not show from either; the property may look to be, and as far as earning capacity goes may be, as good as new. Nevertheless, every year of use or work is a year taken from its working life, and provision must be made for its final replacement or this replacement will inflict a heavy loss in the future. With this idea of replacement in mind, therefore, a percentage may be written off the present value, though any apparent depreciation is not present. If such is the case, then it is really an adoption of the depreciative rate.

Adjustment Values

It is well to write off sufficient depreciation during the first years of the working of a plant, even if there are evident no signs of a lessening in value, as by such means the valuation will stand in case of any fire loss covered by insurance. In a fire insurance adjustment a yearly depreciation is figured off from the original cost or value of

the property, regardless of replacement value, and it is often disappointing to find that values, as standing in the books of the company seem inflated in case of loss by fire.

As a consequence of the reasons given, and particularly on account of the difficulties of time and expense standing in the way of the carrying out of a system of periodic valuation, this system is little used. The plan which is in general use, and the one next in accuracy to the plan of periodic valuation, concerns itself with the establishment of average rates, which are written off yearly or semi-yearly. As a check to the accuracy of these calculations, valuation—either complete or partial—may be taken as often as deemed practical.

Contributory Causes Specified

Depreciation has been defined as a lessening in value from age and contributory causes. These contributory causes may come from or be modified by other causes than what is commonly termed "wear and tear." Physical condition and the elements affecting it are first thought of in connection with depreciation, but the value of any material property may be affected to a great extent by influences not in common with such physical condition. These contributory causes may be enumerated as: (1) Tenure of holding; (2) probability of uniform, regular, or increasing employment; (3) exhaustion of (a) base of manufacture, or (b) field for disposal of manufactured product; (4) probability of

improved methods, processes, equipment, or the like, making of no further practical use the specified property; (5) those unforseen events which no prudence, however great, can guard against or provide for. These and similar conditions, are more to be considered as under the head of amortization, than within the province of depreciation, and excepting only in rare cases, it is best to so provide for them in allocation or accounting.

Tenure or Holding

(1) As regards the item of tenure or holding, there may be various cases. A common case is that in which the building is merely rented. Usually the lease will contain a covenant to repair, which has been adjudged to mean "to keep the premises in as good repair as when the agreement was made," but ordinary depreciation can hardly be said to call for any extensive repairs.

In case the agreement or conditions should be such that the trade fixtures and appurtenances become the property of the landlord, the need of a sinking fund becomes apparent at once, as capital so invested becomes a loss at the expiration of the lease. The law—ever subject to liberal interpretation when trade is to be encouraged—does not compel as high a class of maintenance as the owner would naturally keep up. The lessee may even permit his machinery to be worked to death before the lease expires, and take toward his sinking fund sums he would otherwise devote to upkeep and maintenance.

(2) In determining depreciation rates the probability of uniform, regular, or increasing employment or the reverse, for the plant, is an important factor.

Permanency of Employment

The entire business may depend upon the validity of certain patents, an act of congress, of the legislature, or a contract for a term of years. But the most disturbing factor liable to upset ordinary business probabilities is the far-reaching effect of the trust. Those classes of manufacture or trade which are subject to trust competition are liable to dangerous interference, or even total extinction within a fair term of years. Because of contingencies of this class, the argument for a high rate of depreciation is a sane one and one that is given more consideration than formerly, when profits were not only larger but more sure. That this depreciation rate should be used in conjunction with a sinking fund for the replacement of sunk capital, is also manifest.

(3) Closely related to cause (2) above and in many cases a subdivision of it, is exhaustion of (a) basis of manufacture; or (b) field for disposal of manufactured product. In regard to (a) may be noted as the best examples, mining or lumber industries liable to exhaustion after a certain period of work. As regards (b) exhaustion of field for disposal of manufactured product, the most evident examples of this class of industries are those depending upon style or fashion for their maintenance.

Manufacture and Disposal of Product

The calculation of the cost of production in all works of the classes last set forth above demands that the allowance for depreciation be a most liberal one. If the demand be reasonably sure but subject to those fluctuations which mark certain lines having slack periods alternating with periods of great activity, a uniform yearly rate may be figured, or more preferably, a high rate figured during the rush and a lower rate during the lull. That depreciation does not stop during disuse or storing is commonly known, but the charge should surely be made large enough.

Figuring Depreciation to Meet Fluctuating Demand

(4) In many lines of manufacture and trade, the probability of improved methods, processes, equipment, or the like, making of no further practical use part or all of a plant, is always a possibility. In certain lines this contingency is so small as to hardly need provision for, as the inertia of the buying public once started, will continue in the face of any but absolute replacement at a lower cost. The trend of invention is always toward automatic production with as little labor as possible—and that low-priced—leaving skilled labor for supervision. This replacement, or liability toward replacement, will not be provided for unless the rate be a generous one.

New Methods and Inventions

Improvement of product is also one of the tendencies of invention, and competition may call for new machines which must be provided for out of the capital

of the plant. Instances of this kind have been very noticeable in the older industries, which have lately been subject to great improvement. In steam laundering the introduction of the smoother for the raw edges of standing collars is an example of a machine designed to improve the product. Such a machine adds a new process to the number ordinarily performed but is demanded by the call for superior work. The protection afforded by the introduction of such machinery as will guarantee a superior product is often more effective than were the same amount retained as a sinking fund; indeed, the progressive American business man deems high efficency of the working plant to be better than high dividends, for he has the utmost confidence that the former will surely bring the latter. It is—as it is almost needless to say—just this spirit which has placed America far to the fore in the race for the commercial supremacy of the world.

New Machines Called for to Improve the Product

(5) There are lines of business and manufacture peculiarly subject to certain contingencies which may not be insured against, because no company can be found to take the risk. These contingencies are not strictly depreciation nor may they come within the scope of the subject, but are worth a word in passing. A mine may be subject to flooding; a dynamite factory to explosion; certain lines of trade lay open to strikes of employés or danger of incendiarism—all of which can not be foreseen nor insured against.

Contingencies Not to be Insured Against

In case a company is large enough and conditions warrant, a reserve fund—separate from that of depreciation—should be maintained, proportionate in size to the amount at risk and the probability of the contingency so insured against coming to pass. This fund, when so obtained, is often entered upon the books under the guise of "Depreciation," when it is nothing more nor less than a reserve fund or a fund for insurance. The reason for this is not hard to be seen. What the stockholder wants is dividends. The future of the company he considers is not his direct business; that devolves upon the officers or the manager. Consequently, to provide a reserve really necessary—particularly from the viewpoint of the manager—what would otherwise be dissipated as dividends is kept under company control disguised as a depreciation fund for renewal of the plant.

Another plan that is sometimes followed is this: The original value of the plant is retained on the company books. Under "Depreciation and Reserve," stands a fund derived from a portion of the profits of the business. Providing no actual misunderstanding results from such designation, it does no particular harm, but it must be remembered that instead of a tangible sum subject to the requirements of the business, the entry shows only loss coming from the age, wear, and contributory causes.

The site of a plant—or more rarely the buildings themselves—may increase in value so as to offset

the natural wear and tear of the occupied structures. This may be brought about by the natural increase of real estate or may be forced by the erection of high-class buildings in the immediate vicinity, or from other and more remote causes. This offset, however, should be considered theoretical, and to be otherwise provided for than by being set over against positive physical impairment, but such depreciation should be treated as though there were no appreciation of site. A revaluation of the property affected by appreciation will not only be more exact, but will be more satisfactory than when set over against the fund caring for depreciation. In providing a basis upon which to calculate depreciation, the value at the time such calculations are begun, is taken. This valuation will be the price paid, providing the plant was purchased outright. In many cases, however, it is desired to equip a going plant with a cost system. The history of most industrial undertakings is one of growth, the plant starting in a small way and being added to irregularly, the increment being the result of the increasing demands of the trade. When such a business wishes the necessary basis for the calculation of depreciation a valuation will be necessary. Here must be combatted the fallacy that actual worth is the cumulative cost of an article or machine, because "it would take that much to replace it," and the valuation should avoid the ever-present danger of inflation.

Appreciation of Site

Depreciation Based Upon Valuation

Continental and English articles of association frequently specify the rate of depreciation to be written off. This might do for conservative ventures in a conservative country where the prospect of success in any line may almost be said to be determinable by probability tables compiled from past records, but for use in a younger country where records of production are consulted only that they may be broken, any method setting a rate of depreciation in the company articles is bound to be inaccurate. This method generally applies a certain part of the profits for wear and tear, but deterioration may be greatest during a season when the profits of the business are smallest.

Method of Calculating Depreciation

Besides the percentage-on-profits plan there are two others, one calculating depreciation as proportionate to the plant output, the rate being determined by the experience of the business during past years; the other plan taking the capital value remaining from the year last past as a basis. This latter plan is for nearly all conditions the one most suitable. Depreciation is commonly calculated at the close of the fiscal year, at which time Upkeep is also summed up and made a charge against the revenue account. General activity, either of the plant as a whole or of certain departments may influence the depreciation rate and raise or lower it proportionate to the amount of production.

The fact that wear is not always immediately visible often leads to a misapprehension that a rate is

too high. Depreciation is partly a provision against certain contingencies. These contingencies may or may not arise. The breakdown of tomorrow may be preceded by no signs that indicate its occurrence. Besides obvious wear and tear, there are always risks—hidden it may be—but none the less a contingency that may be either near or remote. A prudent and conservative course may demand a much higher rate than would seem necessary from the closest calculation of wear and tear.

Lack of Uniformity in Systems

No uniform system is in operation in various plants, to provide for depreciation. Even in precisely the same lines of business, working under substantially the same conditions, methods will be at wide variance and still considered satisfactory by their users. In one shop repairs are given almost the entire attention, a tool room is maintained with several skilled operatives who devote their entire time to repairing, renewing, and remodeling machine tools, yet the rest of the plant may be left with little or no upkeep, and no provision whatever is made for depreciation. In other cases repairs are neglected and profit is rapidly written into a depreciation and sinking fund. These two cases cited are extremes and every gradation exists between them. Often when the same general plan is used the percentages are radically different.

Blanket depreciation of the entire plant, covering buildings, fixtures, tools and rolling or delivery stock,

is not as common as formerly. This method is wrong in theory even if it does sometimes work in practice.

Simplicity of Blanket Depreciation

As said in a previous chapter of the direct-burden plan of allocation of factory cost, its chief merit is simplicity, with the corresponding drawbacks. When the application becomes complex, the simple system is liable to be lacking. Buildings and machinery not only call for different rates but they are almost invariably subject to entirely different management in regard to repairs and upkeep. Who does not call to mind a money-making plant the buildings of which seem on the verge of tumbling down, windows cracked and obscured with cobwebs and dirt, while within the shop is every modern tool, kept in the highest possible state of efficiency?

Where blanket depreciation again fails, may be seen when certain departments of a plant are obliged to work up to their full limit while other departments are experiencing slack times. Deterioration in one part may be double or treble that in another.

Division of sunk capital into classes for the reckoning of depreciation must depend much upon the scope of the business. A general manufacturing plant renting its building would probably need but few divisions for this purpose: Fixtures; fixed tools valued above $50; lesser tools; engines or motors; etc. If the plant were larger and owned the land and buildings, land and buildings would be added. In organizing a new business, preliminary

Classification

expenses of establishment may be considered as subject to an annual writing off. No difficulty will be experienced in classification for depreciation purposes. The underlying principles of classification are so broad, that even the most elemental knowledge of a business will be guide enough for their application. Over against this, however, is set the difficultly accompanying the proper determination of rate, which calls for long experience combined with rare and exact business judgment.

Land or Site

The depreciation or appreciation of land occupied as a site has already been touched upon as coming within the province of revaluation rather than depreciation. There may be said to be one exception, however. Fairness to future stockholders may require that some contingency be provided for by writing off a certain sum annually. Events may require the removal of the factory within a certain period of years. It would be no more than just that depreciation be charged against the land and not leave the entire loss to fall on the stockholders at the time of such removal. Generally speaking, however, depreciation is not meant to be charged against land.

The subject of depreciation ratings is one that can not be covered by general formulas. However, a number of examples are given as used by fire insurance adjusters. It must be remembered these percentages are based on the actual life of the building without any repairs; also that they tend to liberality of reduction if any

bias exists. The following percentages are as given by Tiffany:

"Brick buildings, slate or tin roofs, used as manufacturing establishments, where there is heavy running machinery, especially when used as planing mills and for the manufacture of sash, doors and blinds, wagons, hubs, spokes, furniture, chairs, and other wood workers, depreciate yearly to a greater extent than those used for less hazardous purposes, and a fair estimate on these classes would be annually 4 per cent. Frame buildings under similar condition depreciate 5 per cent. With shingle or gravel roofs, occupied for same purpose as described, depreciate annually 4½ per cent; if frame, 6 per cent."

Depreciation of Machinery

When we come to the matter of machine depreciation, we have a subject not only complicated in theory but one on which both theoretical and practical authorities are at variance. And there is the best of reason why such variance should exist. Opinions are commonly the result of experience—and the nearer home the experience came to one, the more positive such a one will be in their convictions. Certain farmers would declare positively that the life of a self-binder was five years or less, because such had been their experience, while others would show a five-year-old machine scarcely damaged and good for many years to come. Similarly differing reports would be given by managers having a shop fitted with high-

priced, complicated machine tools. One would declare that as a result of his experience that 15 per cent yearly was none too much to write off, while another would consider 5 per cent yearly, a liberal allowance.

Ewing Matheson, one of the leading authorities on the subject of depreciation says:

"In regard to the proper rate of depreciation for machinery, there is, even in well-managed factories of similar class, a wide divergence of practice. Thus in a new factory doing a profitable business, private partners will, in their desire to be on the safe side, sometimes commence by writing off annually 10 per cent from machinery of all kinds. Unless there be some apprehension of the plant becoming obsolete, this is generally too liberal a rate for fixed machines, unless it is neutralized in some other way. In other cases, the records of many years' working may show that 2½ per cent is sufficient, because the machinery was good in kind and quality to begin with, partly also because the expenses of installation and of liberal repairs have been defrayed out of revenue, and partly because the machines have been moderately worked.

"In engineering factories the rate which will probably meet the deterioration will generally be found between 5 and 10 per cent. Where the work is of a moderate kind which does not strain the machines severely, and where the hours of working do not average more than sixty per week, 5 per cent would generally suffice

for machinery, cranes, and fixed plant of all kinds, if steam engines and boilers be excluded. Where there is a diversity of machinery and plant, and the past accounts of twenty years to refer to, it is not difficult to arrive at an appropriate rate and to make periodical revisions."

The percentages given by Tiffany are as follows:

"On all machinery, as a whole, including shafting, gearing, pulleys, bearings, and all connections, used in manufacturing establishments, such as planing mills, furniture and chair factories, and other wood works, there is a considerable deterioration in values, and the very best authorities regard as correct a depreciation the first year of 12½ per cent, and every year thereafter 10 per cent. On all machinery used in iron works there is an annual depreciation of 6 per cent.

"Machinery, as a whole, in a flour mill, will not depreciate in value to as great an extent, annually, as that which is in a wood-working establishment, and should therefore have a specific per cent of depreciation. The following may be relied upon as equitable, as it is based upon the experience of some of the most practical millwrights in the country: Machinery in a flour mill will depreciate the first year, 12½ per cent; the second year, 8 per cent; the third year, 5 per cent; the fourth year, 2½ per cent; the fifth year, 2 per cent, and every year thereafter, 2 per cent. An engine, properly set and under the exclusive charge of a competent and careful engineer, will depreciate annually 5 per

cent. The average life of a boiler is ten years, and the annual depreciation should be 10 per cent.

"In giving the percentages of depreciation on engines and boilers it is assumed that a careful and competent engineer is employed, and that they are well cared for. Where this is not the case the per cent is largely increased, and many cases have been known where, in less than five years, they have been, through carelessness, rendered entirely useless and consequently worthless."

The matter of depreciation of drawings and patterns is one intimately connected with estimates and is referred to the topic "Patterns," in the chapter "Estimates."

Patents and copyrights theoretically are subject to the regular depreciation of lapse in a term of years, the protected life of a patent being 17 years and of a renewed copyright 42 years. Practically, however, the depreciation is greatly in excess of the theoretical rate, because of the danger of superseding inventions or copyrights.

There are two methods in wide use for the calculation of depreciation, the first reckoning on the original cost; the second, on the value after the preceding years' depreciation has been deducted.

Depreciation has been spoken of earlier in this work as an uncertain factor. It is, and can not be made otherwise. But it can be made a *safe* factor by conservative writing off. To make the percentage writ-

ten off large enough to meet the aims and protect the welfare of the business and yet not introduce too large a factor into Factory Cost, so restricting the sales department in their battle for trade, calls for a thorough knowledge and business technique granted but few. This, however, is a matter of education and application no more difficult than the innumerable problems that are daily taken up and satisfactorily solved by practical business men.

CHAPTER XI

SELLING EXPENSE

The factor coördinate with Factory Cost is Selling Expense, the two going up to make Cost to Make and Sell. Selling Expense comprehends six factors, which will be treated in detail hereafter: (1) Office; (2) Salesmen; (3) Estimating; (4) Advertising; (5) Traveling, and (6) Indirect Expense. Each of these factors lie well within the limits of Selling Expense, with the exception of (6) Indirect Expense, which comprehends, or may be made to comprehend, certain expenses which result from or grow out of administration instead of selling.

In the strictest sense, Selling Expense forms no part of the cost of production. An article is produced when Factory Cost lays it down at the works door. But the business man says: "I have no use for this product unless I can sell it. Production is all right, but it must have added to it the complement Selling Expense, in order that I may have a working basis." To furnish this working basis, to the cost to produce, or Factory Cost, is added Selling Expense and the manufacturer knows as Cost to Make and Sell what his product stands him in and he is able to govern his business affairs accordingly.

The functions of making and selling call for the

exercise of vastly different organization, methods, and most of all, widely differing faculties of mind. The line between the two is clearly and sharply drawn. The constructive mind is satisfied when the machine is complete, every part working smoothly and ready to perform its individual functions. Having completed the manufacture, the engineer or mechanic regards that problem as solved and calls his job completed and turns his attention to other things. Not so does the commercial mind act. The salesman takes the thing to be sold and concerns himself alone with its disposal. Worth to him is an essential in so far as it helps sales.

It is not difficult to see from what different viewpoints Production and Selling look at the same problems. Nor is it to be wondered at that years of life side by side have led the one to look upon the other with mere tolerance if not with misunderstanding, the two differing business divisions being linked together by interest alone.

Therefore, in practice as well as in theory, there is little or no difficulty in separating the expense of selling from the expense of making. If there be any difficulty, it will usually concern some small item which, distributed over the entire cost of production, does not affect the results to any material degree.

The allocation of Burden has been thoroughly taken up in these pages, and it has been shown that there is an existing relation between Burden and Prime Cost and the elements of Prime Cost, Material and

Direct Labor. No such relation exists between Selling Expense and any of factors or elements of Factory Cost. The cost of the commercial disposal of an article has nothing to do with the cost to make it. The demand may be such that the product is eagerly purchased at the factory door, in which case the only expenses are few and indirect, giving rise to the equation, Factory Cost: Selling Expense:: 1000: 1. On the other hand, a plant may be engaged in the production of a nostrum which requires that immense sums be spent to further the disposal of the product when made, in which case the equation may stand: Factory Cost: Selling Expense:: 1: 1000.

The fact that there is no existing relation between Selling Expense and Factory Cost does not mean that no means for the distribution of the expense of selling must be provided. If Direct Labor or Prime Cost is made to bear the burden of Selling Expense, it is a very simple disposal of the subject, but one having only its simplicity to commend it. The ideal—and impossible—way would be to have each unit of product bear its proportionate burden of Selling Expense by being debited for the exact cost of selling it, but this would call for a cost system so complicated that it is hardly worth mentioning except by way of illustration. This being in the realm of the impossible, the compromise nearest correct must be taken as a basis of a method for allocating the expenses of selling. This gives a choice of three methods for the distribution of the expenses of selling:

(1) On Direct Labor; (2) on Factory Cost; (3) on number of hours required in production.

No general statement can be made as to which of these three methods is preferable. In general manufacturing the last method is in successful use and considered favorably. That the taking of the number of hours required in the production of a certain product as a basis for the distribution of the cost of selling is an arbitrary one must be at all times remembered and corresponding allowances made. The following excerpt from an article by A. Hamilton Church in the Engineering Magazine, gives an excellent method of dealing with this troublesome subject:

"The most practical method of correcting the errors introduced by the artificiality of the basis of distribution, is by means of classification whereby the incidence which would otherwise fall equally on each kind of work is made to fall unequally. A number of classes are created, the incidence in the first of which is, say, 100, the incidence in the second being 120, that in the third and fourth perhaps 150 and 170 respectively, and so on for as many classes as may be found necessary. Leaving aside for the moment the considerations which determine in what particular class any given article shall stand, it is evident that if we have a thousand dollars to distribute, the first class will get off lighter and the last class will be more heavily debited than on an ordinary averaging plan. Therefore, if any reasonable means of classifying articles can be devised which

shall correspond as closely as possible to the differences in their commercial treatment, the arbitrary character of the original basis will be to a large extent minimized. There still, however, remains the objection which must never be lost sight of when consulting the figures, that an undue rise in production cost will lead to a disproportionate absorption of general charges, in whatever class the article may happen to be.

"The process of determining the classification is, unfortunately, somewhat difficult, or at least demands a good deal of thought and care at the outset. Space will not permit of its full treatment here, only the principle followed can be detailed. Every item of general charges must be tabulated. The average annual cost of advertising, traveling, drawings, patterns, catalogues, correspondence department, cashiers and bookkeeping, management, and all similar expenditures must be got out and arranged in columns. These are the items of which the incidence has to be settled. Now, against these has to be placed each of the different classes of articles manufactured, and each one of these has to be carefully reviewed with relation to each of the items of expense.

"Thus, for instance, advertising. Analysis of the advertising expenditure may show that one article has practically no concern with advertising. Of this class an obvious example is repairs to the firm's own products. Other articles, on the contrary, may involve special advertising, and should, of course, be debited with the whole of such special expense. Catalogues are

open to similar analysis. Such items, again, as are standard articles supplied either from stock or from standard parts, involve much less of the expenditure due to correspondence than do special jobs. Repairs, on the other hand, although escaping the advertising debit, should be visited heavily on the correspondence and bookkeeping sections, since these small jobs cause as much work to these departments as do standard orders of fifty or a hundred times their value. From this brief description it will be seen that the general establishment charges are capable of a very detailed analysis. It is true that the element of judgment is very strongly involved in this analysis, but there is a difference between judgment and mere guesswork. There is no reason why a very close approximation to facts should not be made at this stage if the work is carried out by a competent person, who has access to all the data necessary for decision."

It will be seen that the success or failure of this system lies in the ability to fix and maintain a satisfactory percentage of incidence. This once found and understandingly applied, the system does what no other method does, distributes the selling burden where it logically and of right belongs. Those classes which call for heavy selling expenses have such expense duly allotted to them; classes which require little selling expense are treated accordingly.

To sum up: The cost of production is obviously not satisfactorily indicated unless first, Prime Cost,

Factory Cost, and Selling Expense are sharply differentiated from each other; second, Burden and Selling Expense are correctly distributed. The second contingency is even more important—if the proportion be large—than the first, and is to be provided for—as are similar problems in costs—by the adaptation of the best method to the problem in hand.

CHAPTER XII

THE FACTORS OF SELLING EXPENSE

The elements making up Selling Expense have been given as (1) Office; (2) Salesmen; (3) Estimates; (4) Advertising; (5) Traveling; (6) Indirect Expense.

By office expense is meant the outlay necessary for the maintenance of a selling office. Theoretically such an institution should concern itself solely with disposal of the manufactured product, but often times a part of office expense, particularly that relating to correspondence, would strictly be chargeable to other elements. No difficulty, however, will be experienced with the calculation and apportionment of this element.

Office Expense

Salesmen or sales expense contributes largely to the expense of selling. It is usual to open an account with each man and keep a careful record of the sales in his territory. The record shows the ratio of sales expense to each dollar of product disposed of and the relative worth of the salesman and the territory as well. The determination of all amounts and percentages relating to salesmen's expense is an easy matter for the accountant and one very essential to the finding of costs.

An estimate is the probable cost of a product as calculated from the best information obtainable, also,

the figures, tables, and accessory drawings made up to show cost or other specifications. The ordinary estimate is a selling expense and chargeable as such. A certain job is required and the specifications therefor—usually more or less imperfect—are drawn up by the prospective buyer. The manufacturer verifies and often works out the specifications in greater detail and submits his price. Often the same specifications are submitted by the buyer to several firms, to one of which he awards the contract. This is a plain example of a case where such estimates are Selling Expense, as they are made to further the sale of a product.

Estimates—to What Chargeable

Estimates may call for drawings, and when filled for patterns or rarely for special machinery. The rule covering special expense incurred in manufacturing a certain machine or product is a general one and may be embodied in the following words: When estimates, drawings, or the like are made to further a sale not made, debit Selling Expense; when the sale is effected such charge may be made against the individual job, providing the outlay is of no more use after the job is completed; if the estimates, drawings, etc., are to be continued in use for future jobs they should be considered a part of Plant Equipment and chargeable as such. This rule is of particular use in drawing-room estimating. It is a rare occurrence that patterns are made up for a contract not yet awarded, but estimates and drawings are often made up as in competition

for a contract. If the business is such that all estimates and drawings are similar, the loss will not be great, as duplicates may be used in bidding for another job. But in many manufacturing plants, the output has a wide range and two machines exactly alike may never be made. It is upon plants of this last class that expenses for estimates and drawings fall the heaviest. There are, as in other divisions of the subject of costs, widely differing methods of treating these charges, but the above rule will be general enough to cover all cases which may arise.

Advertising and Good-Will

The element Advertising is a selling expense in one sense and in another sense an investment. A firm manufacturing furniture, let us say, finds they have on hand several typewriting machines for which they have no use. They expend the sum of ten dollars for advertising to dispose of the machines. Such advertising is an expense; they bought so much space in an advertising medium, the typewriting machines are disposed of, and there is an end to the transaction. Now, this same furniture firm may spend ten thousand dollars in one season for publicity—to get their name prominently before the public. The seed thus sown may accelerate trade for a decade—for several decades, it may be. A great part of such advertising is in the nature of an investment. It creates—or aids in creating—a valuable asset, Good-will, which is possibly worth more than the remainder of the plant. This is generally the case

where the good-will carries with it the right to use some widely known trade-mark or trade name. In charging off advertising expense a medium ground is advisable. A certain percentage of general advertising is an expense and chargeable as such; the remainder goes toward the purchase of Good-will, an asset of the plant. No general rule can be given for the ratio existing between these two parts. Indeed two persons having the same knowledge of and experience in the same business would have widely varying views, depending upon the sanguineness with which each looked upon the future. One might hold that a certain sum had been expended and the actual results from such expenditure were so many dollars; the other might as truly say that results would come in, directly and indirectly for a long term of years. A compromise view places faith in the actual experience of the past as a guide to the future and is neither too sanguine nor severe and proportions the expense and investment accordingly.

Traveling Expense

Traveling expense may be variously classified. Transportation used by salesmen is usually charged to an account so as to furnish a basis for determining the ratio of expense to sales. Traveling done in the interest of the company may be either a legitimate selling expense, an administrative expense or a perquisite of an official, but generally is chargeable to Selling Expense.

Indirect Expense includes the salaries of officers

and directors not chargeable as Direct Labor or Profit, various other minor expenses not chargeable elsewhere.

Indirect Expense

Besides these, there are constantly coming up extra concessions, as free repairs, special discounts for cash on installment or overdue debts, etc., which might be termed Doubtful Debt Reserve. For instance, a buyer who has always had an A1 reputation purchases a bill of goods on ninety days' time. The collector for that territory learns he is in financial difficulty and accepts 75 per cent of the face of his account not yet due, for a cash payment.

No general rule can be given as to what items are to be included in Indirect Expense. These expenses differ greatly in different businesses and vary widely in amount in the same business at different times. The tendency to dispose of doubtful items by placing under Indirect Expense, should be carefully guarded against.

No Rule for Direct Expense

While nothing is so fatal to the worth of a cost system as an endless hair splitting over the technicalities of the higher mathematics of bookkeeping, yet the other extreme, the making of General Expense or Indirect Expense a catch-all for the accumulative odds and ends of expense, is to be just as strongly guarded against. The lines between Prime Cost, Burden and Selling Expense kept sharply in mind, there should be no great difficulty in deciding to which of the three main groups of great expenses an item—however obscure—belongs.

With the element Indirect Expense, we come to the last constituent of the factor, Cost to Make and Sell. This factor is the real objective point of the science of costs. This once determined, the calculation of the remaining factors is a matter of simple arithmetic.

CHAPTER XIII

PROFIT

Profit, in the science of costs, is the excess of the selling price over the cost of making and selling. This meaning of profit is not to be confounded with the meaning in political economy, which is, "what is left of the product of industry after deducting the wages, the price of raw materials, and the rent paid in the production, and is considered as being composed of three parts —interest, risk or insurance, and wages of superintendence."

In the preceding chapter it was said that the objective point in the science of costs, is the Cost to Make and Sell. The objective point in a business, however, is Profit. There can be no *exact* definition of Profit, for the only terms in which it is definable are relative. What would be a profit in one business would be a loss in another; what shows as a profit in the bookkeeping of a corporation may be a loss disguised at the expense of some other constituent element of cost. Upon the accuracy of the determination of the intermeshing factors depends the worth of what the books declare a profit.

It has been previously stated in these pages that Profit comprehends and must take care of Interest,

Discount, Rent, if the plant owns the buildings, and like charges. There are two prime reasons for this.

Profit Comprehends Other Factors

First, these items are a part of the price which the buyer pays, but can not be said to be a part either of warehouse cost or inventory valuation. Second, in these days of high finance, the amount of capital of a company may bear one of many ratios to the amount actually paid in, so by placing interest payments on stocks and bonds as a part of profit, no matter what the apparent ratio of capital is to cash paid in, it is disposed of equitably.

A third objection is given by F. A. Halsey, in a lecture given before the mechanical engineering students of Cornell University:

"There is one item which is usually included in the burden, which it does not cover, and which occupies very debatable ground. I refer to the item of interest on the value of the tools and plant, which is usually added to an allowance for the depreciation due to wear and tear, the sum being treated as a single item called Interest and Depreciation. Of the correctness of the depreciation charge there is no doubt, but as much can not be said for the interest charge. I am not prepared to condemn this practice outright, but it is necessary that its questionable nature be shown as well as the fact that those who advocate it have at least a case on their hands to defend, and that, even if their principle is right, their practice is usually wrong. This charge as usually made is in flat defiance of the fundamental

principle of modern bookkeeping—that is, double entry bookkeeping. I refer to the principle that every transaction and every charge of whatever nature must appear on the books as a transaction between two individuals—fictitious or real, as the case may be; that is, there must be no charge without a corresponding credit. Now, against this interest charge there is nowhere, on any book, in gross or detail, directly or impliedly, any credit whatever. It is simply lugged in bodily from nowhere. If the principle is right, there is certainly a screw loose somewhere in its application."

Speaking further on the same subject, Mr. Halsey says: "There is one argument in favor of charging the interest on the cost of the tools which has weight, even if in principle the practice be wrong. The placing of the interest charge in the allowance for profit means that it is necessarily added as a flat percentage, which ignores the different values of the tools on which the work is done. The importance of making the more expensive tools carry their fair proportion of the burden is so great, and so many influences exert themselves against it that it may be fairly argued that to accomplish this, the interest charge should be placed on the tools, but if this is done, cross entries between the ledger accounts should be made in such a manner as to relieve the interest and discount account of the amounts charged against the tools. I am not aware that this has ever been done [this in 1901], but, nevertheless, the common practice can not be defended. By no possible

argument can a double charge for the same item be justified."

For the various reasons given above and for numerous other minor reasons, it seems logical and in keeping with the science of costs as now practiced, to include the interest group of elements in Profit. Profit then takes care of the investment in its entirety and if the stock be heavily watered does not throw as an expense upon Burden a load which it should not be made carry.

Profit is related so intimately with the three elements Depreciation, Upkeep, and Sinking Funds, that there may be said to be a qualifiedly fixed ratio existing between them. As an extreme case, let us take a get-rich-quick plant. Suppose this plant to be outfitted, running, and doing what would be conservatively called a good business. Their normal profits would probably be 8 per cent on the capital invested. But the promoters have other plans. Only such repairs as are absolutely necessary are made, depreciation charges are marked down to a minimum or disregarded altogether, no sinking fund is maintained and a dividend of perhaps 20 per cent is declared. It is evident that 12 per cent has been misappropriated and if the same course is continued that this percentage will have to be returned by means of assessments or the business will eventually have to close.

At the other extreme the ultra-conservative manager stickles for a large sinking fund, keeps in repair the entire plant, extending it wherever efficiency de-

mands and then trims down to the lowest possible percentage the annual dividend to stockholders, on the theory that dividends paid out are out of the control of the management.

These two types present the two extremes of management, and it is safe to say there is every grade between them.

The amount of profit depends, therefore, taken aside from the question of business management, upon the sums allotted to related elements.

With Profit is reached the final element entering into the cost of production. Selling Price, comprehending all the elements previously treated is of relatively small concern as compared with those constituent elements. Indeed it may be said that one having a grasp on Material, Labor, Depreciation, and Selling Expense is a long way on the road to a thorough understanding of the science of costs.

PART II

ILLUSTRATIVE COST SYSTEMS

CHAPTER XIV

A FACTORY COST SYSTEM

BY EDRIC C. WARREN,

General Manager and Secretary of the Century Stove and Manufacturing Company

The first points in importance in factory cost system are the factory records. These should be simple, and should, with as little detail as possible, accomplish the results striven for. With the system here shown, every hour of labor is accounted and paid for on some order or in non-productive labor.

This system uses two time sheets, the first being the simplest form that it is possible to use. On this the workman indicates his time, the card being known as the workman's check.

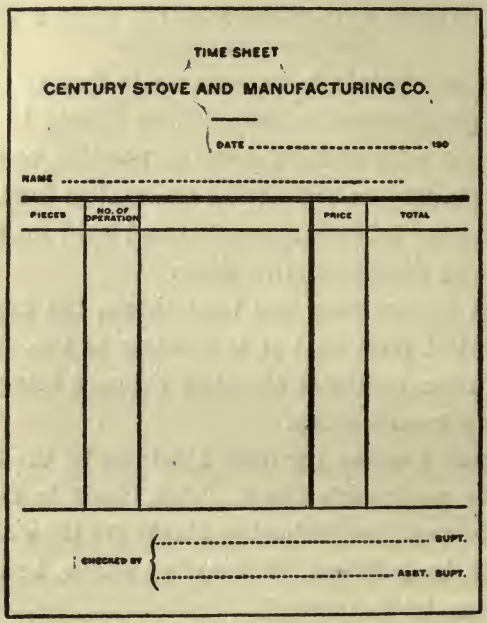
Figure I shows the form filled out by the foreman from the workman's check. This check is not illustrated, as any form which has blanks for the workman's time will be sufficient. It may, of course, be made as comprehensive as desired.

Figure II is a requisition blank, which is used by the foreman for material wanted. Another form is used by the stockkeeper, and follows material from the stockroom.

Figure III and the carbon copies made from it are the order sheets, the original of which is kept

in the office. As many carbon copies of Figure III are made as there are departments through which this order must run. These forms cover all the business that is done in the cost system.

To get a practical demonstration of its operation,


TIME SHEET

CENTURY STOVE AND MANUFACTURING CO.

DATE 190

NAME .....

PIECES	NO. OF OPERATION		PRICE	TOTAL

CHECKED BY ..... SUPT.

..... ASST. SUPT.

FIG. I

we will follow an order through the factory. The requisition for the order is furnished by either the superintendent or the manager, and the number of copies which are required for the factory are specified on the order requisition. The clerk makes out this order, sends the duplicate order sheets to the superintendent, files the

white office copy in book marked "uncompleted costs," makes a card index for the order number, and indicates of what it consists. The duplicates of this order are then distributed to the different department foremen through whose hands the order must pass.


REQUISITION

DATE ..... 190 ....

FOR ORDER NO.

.....EMPLOYE

.....FOREMAN

FIG. II

All raw material is stored in a warehouse; no material is carried in the factory except such as has been requisitioned for some order number. Sheet metal work and machine work are made up on special orders, and the cost is obtained on this part of the work. The foreman, who starts the order, orders the material on Fig-

ure II from the stockkeeper, and furnishes each man who goes to work on the order with his required card, with the check number of the order in its proper place. This slip is turned in to the foreman when the job is completed or at the end of the day. The foreman fills out the office time sheet, Figure I, from the several time sheets which have been turned in by the workmen during the day. Figure I is then turned in to the office.

Labor is figured by the clerk, and entered under the proper order number in the columns marked "Labor from Time Sheets." When the stockkeeper has filled out Figure II, on which he places the weight or count, it is returned to the office and entered under the head "Material" against the proper order number. Completed parts, bolts, and other small fittings, which are used in common and are not ordered for any particular order number, but are kept in stock in the factory, are placed on the foreman's order in the column marked "Material Used," which is not shown on requisition blanks. As soon as foreman is through with his work on any order he returns his blank to the office, marked "Completed." When all blanks have been returned to the office the costs may be estimated very quickly and accurately. The hardest problem with which the company has to contend is the matter of non-productive cost. It has finally adopted the plan of keeping track of this item of cost from the time sheets for the two weeks, and the percentage which this amount is of the whole

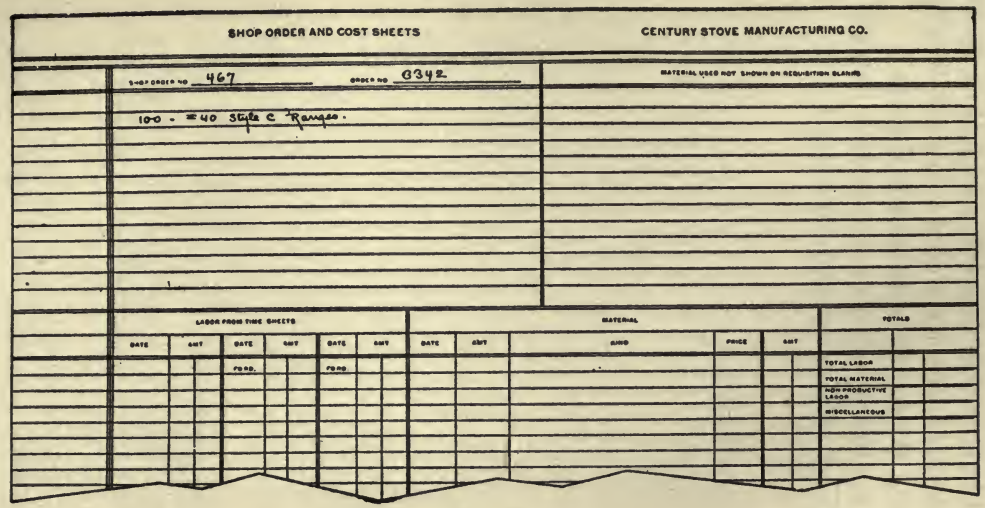

SHOP ORDER AND COST SHEETS
CENTURY STOVE MANUFACTURING CO.
SHOP ORDER NO 467
ORDER NO 6342
MATERIAL USED NOT SHOWN ON REQUISITION BLANKS
100 - #40 Style C Ranges.
LABOR FROM TIME SHEETS
DATE
AMT
FORD.
MATERIAL
DATE
CAT
KIND
PRICE
AMT
TOTALS
TOTAL LABOR
TOTAL MATERIAL
NON PRODUCTIVE LABOR
MISCELLANEOUS

FIG. III

payroll is the percentage which is used as the basis of the non-productive costs on all cost sheets which are estimated during the succeeding two weeks.

When the cost sheets are completed, they are placed in a binder, marked "Completed Costs."

CHAPTER XV

REGARDING FACTORY COSTS

BY L. A. ELY

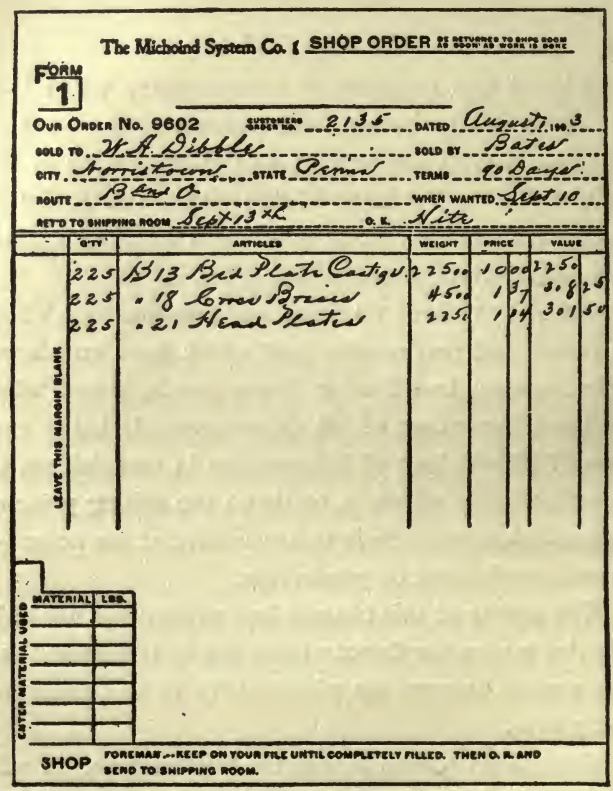
Almost any progressive manufacturer will admit that few items concerning the expense of the business are of such vital importance as the knowledge of the cost of articles. Yet many of these same manufacturers merely estimate the cost of production on many articles when they determine the selling price.

To what records do firms and corporations which are considered progressive, and which have an almost perfect system in all other departments, resort when this most important of all departments is being considered? Their lack of information is astonishing, as the only way in which to settle on the selling price of a manufactured article is to first arrive at the actual—the estimated—cost of production.

The writer of this chapter has endeavored not only to devise a plan for factory costs but to illustrate it as well, and to arrange its adaptability to any manufacturing firm.

Attention is called first to the illustrations. It will be noted that the forms shown may be arranged for either the typewriter or the autographic manifolder, on a regular padded form, inasmuch as that the entered order bears the date of entry. By this system such firms

as care to embody their stock order in the same list with their shop orders may do so. Others may with but little additional time and expense operate independent sets.



The Michoind System Co. { SHOP ORDER BE RETURNED TO SHIPS SOON AS SOON AS WORK IS DONE

FORM 1

OUR ORDER No. 9602 SUPERSEDES ORDER NO. 2135 DATED August 1, 190 3

SOLD TO W. A. Dibbler SOLD BY Bates

CITY Norristown STATE Penna TERMS 90 Days

ROUTE Blue O WHEN WANTED Sept 10

RET'D TO SHIPPING ROOM Sept 13th O. K. Nitz

QTY	ARTICLES	WEIGHT	PRICE	VALUE
225	B13 Bed Plate Castgs.	2250	10 00	2250
225	" 18 Cross Brace	450	13 7	30 82 50
225	" 21 Head Plates	2250	13 4	30 15 00

LEAVE THIS MAROON BLANK

ENTER MATERIAL USED

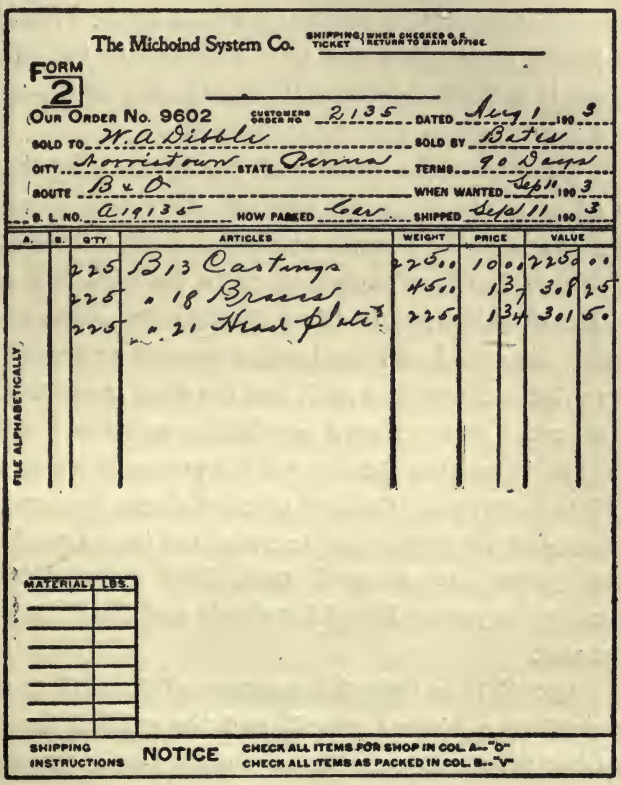
MATERIAL	LBS.

SHOP FOREMAN—KEEP ON YOUR FILE UNTIL COMPLETELY FILLED. THEN O. K. AND SEND TO SHIPPING ROOM.

FIG. I

When made out in triplicate, the shop order (Figure I) goes directly to the shop foreman. On it, as

soon as the work is finished, he checks the items and enters a memorandum of the material used, with such other notations as may be required. Then it is sent to



The Michoind System Co. SHIPPING TICKET | WHEN CHECKED O. K. RETURN TO MAIN OFFICE.

FORM 2

OUR ORDER No. 9602 CUSTOMER'S ORDER NO. 2135 DATED Aug 1 190 3

SOLD TO W. A. Dibble SOLD BY Bates

CITY Norristown STATE Penna TERMS 90 Days

ROUTE B & O WHEN WANTED Sept 11 190 3

B. L. NO. a 19135 HOW PACKED Car SHIPPED Sept 11 190 3

A.	B.	QTY	ARTICLES	WEIGHT	PRICE	VALUE
		225	B13 Castings	2250	10.00	2250.00
		225	" 18 Brasses	450	13½	30.94
		225	" 21 Head Plates	2250	13¼	30.15

FILE ALPHABETICALLY

MATERIAL	LBS.

SHIPPING INSTRUCTIONS NOTICE CHECK ALL ITEMS FOR SHOP IN COL. A—"O" CHECK ALL ITEMS AS PACKED IN COL. B—"V"

FIG. II

the shipping room, where it takes in return a receipt for the articles which accompany the order.

The second of the triplicate orders (Figure II)

goes directly to the shipping room, where it is filed in a suitable drawer until the form from the shop, which bears the consecutive number, is presented, when the material is listed and priced. Then it is properly checked as packed for shipment, and if shipped the bill of lading is attached and it is returned to the office, where it is filed alphabetically or attached to the original correspondence in the vertical file.

When the order is received, the third, or duplicate, is at once placed in the unfilled order file, where it remains until the return to the office of the other forms which, as has been explained, go to the workshop and to the shipping room. Then the data from the other forms are added and the invoice is made according to the price and terms as sold, and the sheet is entered by consecutive numbers on a post binder and a card made out and indexed to the name of the person to whom the article is shipped. On each of these sheets appears the number of the ledger page to which the transaction has been posted, or a small card, filed alphabetically, records the proper file of the sheets and the history of the case.

Should it be desired the reverse of the card or slip is used as a history record, and the printed form is printed to suit the conditions. Spaces may be arranged for a number of workmen. Proper dates could be printed at the top of the card or form, under which entries could be made from the time checks of the workmen engaged on any particular job.

The running expenses of the factory should be entered on this card according to some agreed basis of cost, after that question has received careful consideration, or data furnished by the several foremen, but in no case should estimate be made a basis. The items of running expense in every instance should be printed on the card or form. The usual material used on jobs could also be printed, provided small spaces are left for the writing in of special items, which might only be called for at odd intervals. The number of men and days, as well as the list of items, will all have to be considered in making up the size of this card. If used in the manufacturing of machinery or farming implements, much more space will be required for the entries than if the system is to be used in the millinery or carpet department of a store.

An Accurate Method of Determining Expense

These items are entered, extended and totaled. Then the other incidental expenses, such as crating, boxes, drayage, freight allowance, and other items of expense, with commissions if sold on that basis, are added. This made into one total gives a very close cost price for that job, which may be said to be the net cost. Then, if the selling or contract price be added, there is a compilation of facts that leaves no question for the manager or owner to ask when he figures on a similar piece of work.

Then, if to this compilation be added remarks giving any special matter relating to the working out of

that job any peculiarity in management, it is of incalculable value to a firm in future estimates.

Again, a firm may have the idea that a certain set of men are wasting time or material. This system presents a means of accurately getting at the truth of the matter by setting two gangs of men at the same job. That will force a comparison of time and material required to produce any given result.

The elasticity of this system admits of its adaptation to any line of manufacturing with beneficial results.

CHAPTER XVI

THE COST OF WOOD WORKING

In this chapter the desire is to present for the consideration of manufacturers a system which will simplify the keeping for ready reference the cost of the manufacture of any article or set of articles. While a wood-working plant is under specific discussion, it is merely by way of illustration and it can readily be seen that the principles involved may be carried into any line where system is desired and with the same satisfactory results.

It matters little what the nature of the article may be, all goods manufactured should be constructed from blank orders which should be furnished to the foreman of each department through which an order passes. The form suggested for this purpose (Figure I) may be adapted to varied requirements. At the completion of a part of the order in any department it receives the O. K. of the foreman, and is sent along to the next department, and so on until the work is finally ready for delivery. This enables the office to learn at any time the exact position of the order without searching through the factory for the desired information. The endorsement of the last foreman having charge of the work should also include the date of the completion of the order.

Orders

If the order is one necessitating its transfer from one department to another on trucks, then each truck should bear a job ticket or tag on which should be entered the order number and the name of the article to be manufactured. The tickets should in all cases accompany the order, the number of which could at all times be told by the workman detailed, and foremen should be instructed to refuse to receive any job from another department without the ticket attached.

Time Cards

One of the essential points in the cost of the manufacture of an article is the time a workman consumes in its construction; often it is of far greater importance than the actual cost of material. In order to properly arrive at that point the adoption of a time card is suggested. This card may be printed in the form of the dial of a clock (Figure II). This plan is suggested for the reason that the most illiterate workman is able to tell time, and his only task need be to place a cross in the hour when he begins work on an order, and another when it passes from his hands. Thus the exact time required for the work in each department through which it passes may be at once determined. Different forms should be provided for each department, as they differ in the operation, but each should retain these chief points: (1) The order number; (2) job number; (3) date commenced; (4) date finished; (5) name or check number of workman; (6) number of pieces and the name of the article. Cards for the various departments

would have the possible operations printed along the side of the card. The idea which it is wished to convey will be found illustrated.

These time cards should be deposited in pockets attached to each machine and should be numbered according to the machine number in order to prevent confusion. Then when a workman starts a job he has but

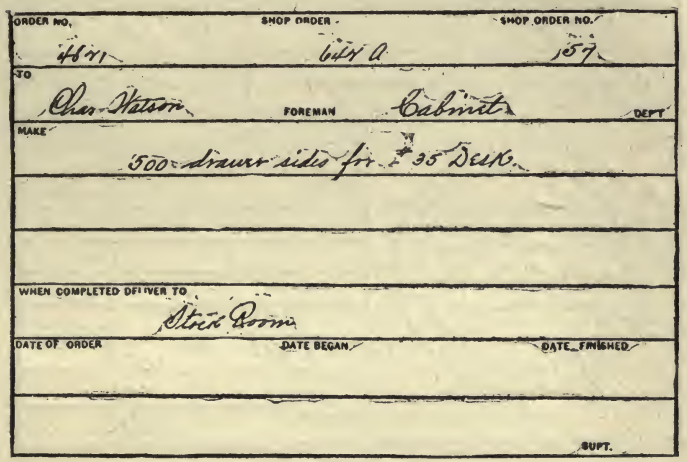


FIG. I

to enter the job number on a card and cross the time when he commences his work. The illustration (Figure III) shows one of these pockets in use. He enters his name, or, if he cannot write, his check number, runs a line through the operation to be performed and when through with it makes another cross on the dial. The plan described, as will be seen, also serves as a check

on the workman for the machine number and the name of the operation or department must correspond. For instance, if a shaper was numbered 26, and the workman crossed out the operation of sawing on the card bearing the shaper number, the time clerk would immediately know that there had been an error made and could trace it. Of course, workmen would be paid for

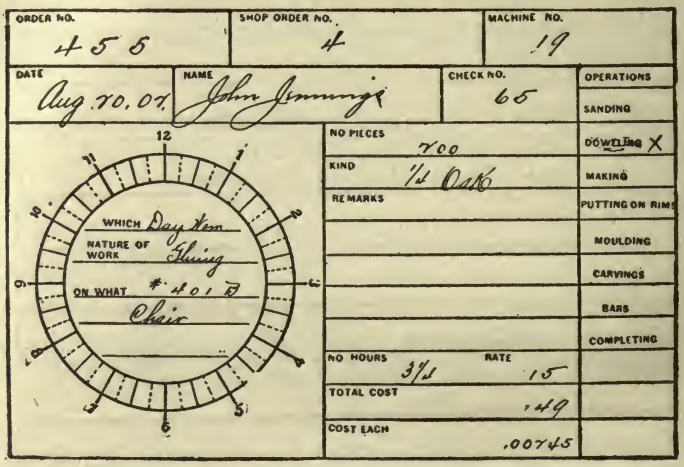


FIG. II

the time indicated on the card. The different cards they turn in each day show the exact amount of time worked, and the exact cost of the labor can thus be obtained.

It is a very simple matter to determine the cost of non-productive labor by computing the cost of the productive labor for a given period in a given department,

and dividing the amount thus obtained into the cost of non-productive labor for the same length of time in the same department. To illustrate: Assuming that the productive labor amounted to $1,000.00 for a given period of time, and the non-productive labor for the same department amounted to $100.00. By dividing as stated above, the result would be 10 per cent. Therefore to the cost of the productive labor add 10 per cent to cover the cost of the non-productive labor.

There should be turned in each day by the foreman of the machine room the exact amount of rough lumber cut. This should include all scrap and waste for each order number.

Cutting Record

In keeping a stock record a card should be made out for each kind of lumber, the cards to be filed between suitable guide cards (Figure IV). When lumber is received it is entered on the card in the proper column, noting the date, from whom received and the amount. The daily reports turned in by the foreman of the cutting room should show the amount of stock cut for each order, and from his reports the amount of stock could be entered. When an order is made out in the office the actual net amount of lumber needed for its construction is determined and entered in the proper column. Thus the amount of scrap and waste can easily be determined by a comparison of the foreman's report and the office estimate.

In determining the percentage of waste, add the various amounts of stock estimated for the different

orders and also the amount of stock cut, and the difference will give the amount of scrap and waste together. The superintendent should estimate the amount of stock in the scrap bin. The difference between the stock there and the total amount of scrap and waste,

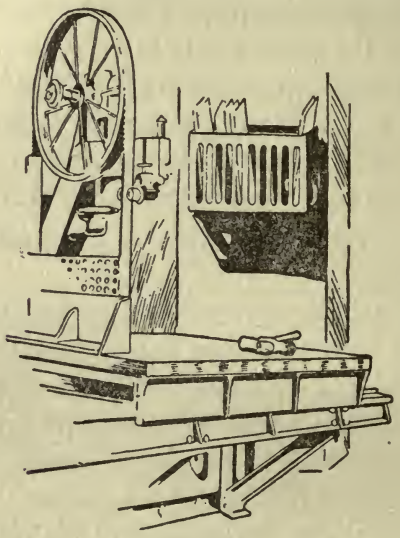


FIG. III

divided by the amount of stock cut, will give the proportion of waste.

Several entries on the card (Figure IV) serve to properly illustrate this. It will be seen that the entries show that on the orders No. 250, No. 251 and No. 252, the office estimate amounted in the aggregate to 3,223 feet. The actual amount of material cut was 4,353 feet. The superintendent finds the amount of scrap to be 354 feet.

The difference between the amount actually cut and the office estimate is 1,028 feet; deducting the 345 feet of scrap.

This result determines the cost of material, and the 15 per cent thus obtained is added to the estimate to cover the cost of waste, and this will give approximately an accurate cost of material.

KIND OF LUMBER White Oak Finish

RECEIVED				USED								
DATE		FROM WHOM	AMOUNT RECEIVED	DATE		ORDER NO	OFFICE ESTIMATE	AMT CUT	AMT SCRAP	WASTE	BALANCE	
7	10	A.D.S & Co	7000	9	7	355	1300	1750				
7	15	" "	5700									
"	18		1500									
9	15	Cummings	7700									

FIG. IV

It is next necessary to ascertain the cost of the complete article. To do this an assembly card (Figure V) is suggested. The cost of the different operations by departments, as will be seen, is entered in the proper column, the operator's name or number and the department, the number of hours employed and the total. Material

Complete Cost

can also be figured with the value and the cost per piece for material, cost per piece for labor, the shop burden or loss, or according to the name of the article. The cards may be filed in one of three ways, either alphabetically, according to the name of the party for whom the order was constructed, numerically, according to the order number, or according to the name of

NO. PIECES	NAME OF ARTICLE	SHOP ORDER NO.
700	#415 O.	54

DATE ORDERED	DATE BEGUN	DATE FINISHED
Oct 1 1907	Oct 4	Oct 15

DEPARTMENT	OPERATIONS	HOURS	RATE	AMOUNT	MATERIAL	AMOUNT
Machines	Sawing	10	17	170	1760' 1¼ Oak	7 50
"	Shaping	14	14	196	Filler	4 76
"	Sanding	18	8	144	Varnish	6 17
Finishing	Filling	14½	70	785	Waste	96
"	Rubbing	19	77	418		
"	Varnishing	17	75	300		
"	Polishing	16½	30	495		
					TOTAL COST MATERIAL	18 89
					SHOP BURDEN	7 47
					COST PER PIECE MATERIAL	06
					" " " LABOR	28
TOTAL LABOR COST ON 700 PC'S				1956	TOTAL COST PER PIECE	34

FIG. V

the article. The forms can easily be enlarged or contracted to meet the particular requirements of factories of any capacity, and it will apply to any line in the manufacturing world.

This system was originally devised for a large wood-working factory in Eastern Pennsylvania, where it was given a thorough trial of five months, beginning from the very day it was installed.

The real merit in the system lies in the fact that while it was devised for a wood-working factory, it has been adapted to many large factories in other lines and there is not a single instance where its simplicity and accurateness has not been commented on favorably.

CHAPTER XVII

ASCERTAINING THE COST OF PRODUCTION

BY E. J. HATHAWAY

Every manufacturing establishment should have a system for ascertaining the actual costs of production. There are many systems in use, but perhaps none that is applicable in its entirety to all lines of business. There are, however, certain general features that govern all such systems and which may be adapted to any line of manufacture with but little variation.

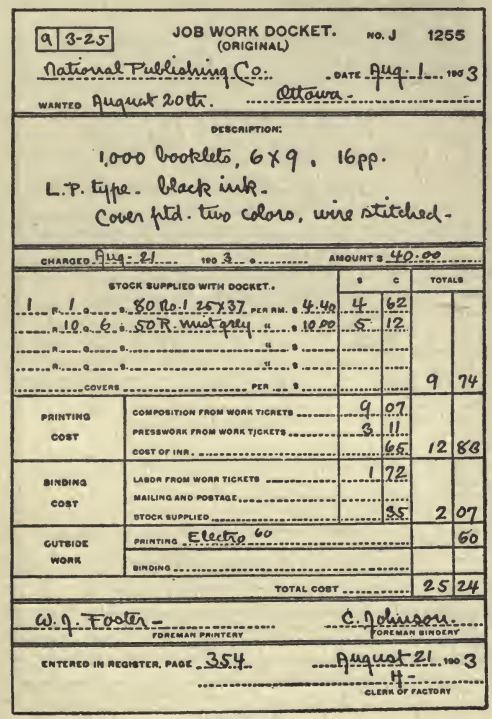
The chief desideratum in a factory cost system is simplicity. It should be easily understood, economical in operation, and its importance to the business should be recognized by every employé. The difficulty with most factory systems is that they are too complicated. They attempt to give too much—much that is unnecessary—and they are too expensive in the handling.

The following system of ascertaining the cost of work is used in one of the largest printing and bookbinding houses in Canada. It is the natural development of many years of experience with cost systems, and is a simple, economical and accurate record of all work passing through the factory.

A work docket, giving the general particulars, description of work, record of paper to be supplied, time promised and other such information, is written in

duplicate, the original (Figure I) going into the factory with the work, and the duplicate (Figure II) remaining on a loose-leaf file in the office.

Every producing employé in the factory is required to hand in a work ticket (Figures III, IV, and V) each



9 3-25 JOB WORK DOCKET. (ORIGINAL) No. J 1255

National Publishing Co. DATE Aug. 1 1903

WANTED August 20th. Ottawa

DESCRIPTION:

1,000 booklets, 6 x 9, 16pp.
L.P. type. black ink.
Cover ptd. two colors, wire stitched.

CHARGED Aug. 21 1903 AMOUNT $ 40.00

STOCK SUPPLIED WITH DOCKET.	$	c	TOTALS	
1 F. 1 80 No. 1 25x37 PER RM. $ 4.40	4	62		
" 10 6 50 R. mist grey " 10.00	5	12		
			9	74
PRINTING COST — COMPOSITION FROM WORK TICKETS	9	07		
PRESSWORK FROM WORK T/CKETS	3	11		
COST OF INK		65	12	83
BINDING COST — LABOR FROM WORK TICKETS	1	72		
MAILING AND POSTAGE				
STOCK SUPPLIED		35	2	07
OUTSIDE WORK — PRINTING Electro 60				60
BINDING				
TOTAL COST			25	24

W. J. Foster FOREMAN PRINTERY C. Johnson. FOREMAN BINDERY

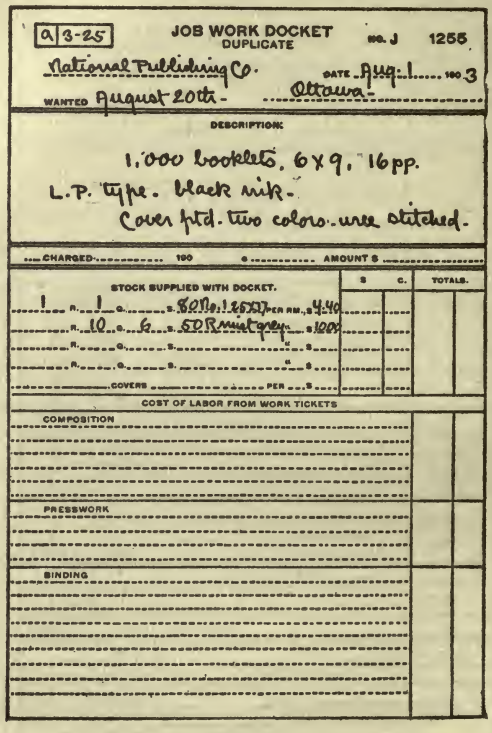
ENTERED IN REGISTER, PAGE 354 August 21 1903

CLERK OF FACTORY

FIG. I

evening, showing a record of his work during the day, giving the docket numbers of the one or more jobs on which he has been engaged, the nature of the work and

the time actually employed on each. The records from these tickets are posted in the office each day to the duplicate docket according to the several branches of the work, each item being checked off as it is entered,



a 3-25 JOB WORK DOCKET DUPLICATE No. J 1255

National Publishing Co. DATE Aug. 1 No. 3

WANTED August 20th - Ottawa -

DESCRIPTION:

1,000 booklets, 6 x 9, 16 pp.
L.P. type. black ink.
Cover ptd. two colors. wire stitched.

CHARGED ..... 100 @ ..... AMOUNT $ .....

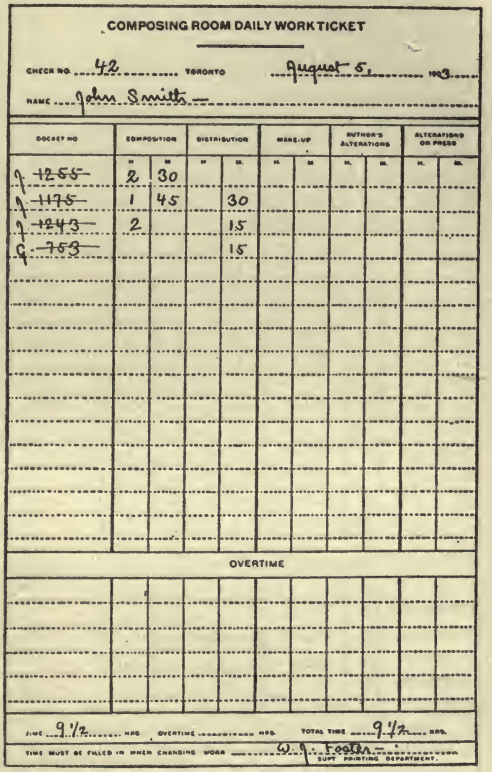
STOCK SUPPLIED WITH DOCKET.	$	C.	TOTALS.	
1 R. 1 @ $ 80 lbs. 1 26x38 PER RM. $ 4.40				
R. 10 @ 6 $ 50 R. multigraph $ 100				
R. @ $ $				
R. @ $ $				
COVERS PER $				
COST OF LABOR FROM WORK TICKETS				
COMPOSITION				
PRESSWORK				
BINDING				

FIG. II

the workman's number appearing above and the value of the time charged below. (Thus in Figure III the first entry under composition, 42/60, indicates that

compositor No. 42 has worked on docket J 1255, to the value of sixty cents.)

As this file of duplicate dockets contains only those



COMPOSING ROOM DAILY WORK TICKET

CHECK NO. 42 TORONTO August 5, 1913

NAME John Smith

DOCKET NO	COMPOSITION		DISTRIBUTION		MAKE-UP		AUTHOR'S ALTERATIONS		ALTERATIONS ON PRESS	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
J 1255	2	30								
J 1175	1	45		30						
J 1243	2			15						
J 753				15						
OVERTIME										

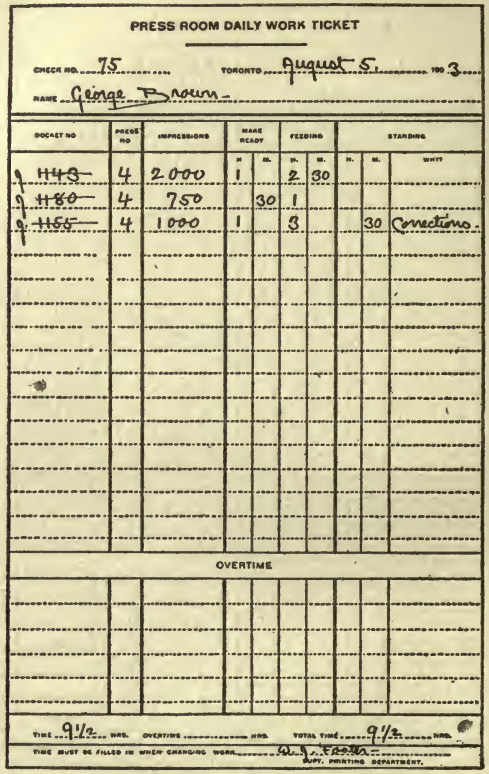
TIME 9½ HRS. OVERTIME HRS. TOTAL TIME 9½ HRS.

TIME MUST BE FILLED IN WHEN CHANGING WORK G. A. Foster SUPT. PRINTING DEPARTMENT.

FIG. III

of work actually in hand, it may be handily referred to at any time for information as to work in progress without the necessity of searching through a number of de-

partments, and a little familiarity with employés' numbers will enable one to know at any time almost the exact condition of the work on any particular job.



PRESS ROOM DAILY WORK TICKET

CHECK NO. 75 TORONTO August 5. 1903

NAME George Brown

DOCKET NO	PRESS NO	IMPRESSIONS	MAKE READY H.	MAKE READY M.	FEEDING H.	FEEDING M.	STANDING H.	STANDING M.	STANDING WHY?
1143	4	2000	1		2	30			
1180	4	750		30	1				
1155	4	1000	1		3			30	Corrections.

OVERTIME

TIME 9½ HRS. OVERTIME ____ HRS. TOTAL TIME 9½ HRS.

TIME MUST BE FILLED IN WHEN CHANGING WORK. Supt. PRINTING DEPARTMENT.

FIG. IV

When the work on a job is completed in any department, the docket is passed on with the work to the next branch, the foreman first entering in the proper column

the value of the ink or other materials that may have been supplied from his stock, and when the job has

NO. 125 August 5, 1903 3

BINDERY WORK TICKET

NAME Mary Jones

DOCKET	HOURS	MIN.	DOCKET	HOURS	MIN.
J. ~~1023~~	3	30			
J. ~~1012~~		45			

TOTALS: HOURS 4 1/4 . 12 . 51

DOCKET	DESCRIPTION OF WORK	RATE	AMOUNT
G. ~~755~~	3,000 - 3 fold.	25	75
	TOTAL		

NOTE GIVE EXACT TIME OCCUPIED ON EACH DOCKET; FILL IN WHEN CHANGING WORK. KEEP YOUR TICKET NEAT AND CLEAN

CERTIFIED BY C. Johnson FOREMAN

FIG. V

finally been delivered to the shipping room, the docket passes into the office, where the amount of labor is

made up on the duplicate, transferred to the original, and the actual cost of the job ascertained. (Figure VI.)

To the prime cost, covering materials and direct labor, must now be added the percentage covering management, maintenance, and other working expenses, in order to find the net cost of the work. The docket as now completed is sent to the invoicing clerk, to be marked with the date of charge and amount, for purposes of reference, and then filed in an alphabetical index. The duplicate (Figure VII) is filed in a corresponding numerical index, and thus ready reference may be made to any particular job by name, number or date at any time.

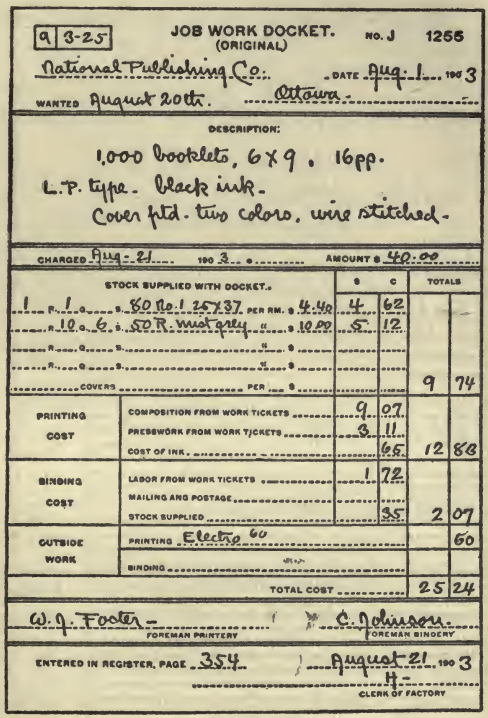
A System That Has Proven Its Value by Actual Trial

This docket system has now been in use for a considerable time, and has in every way proven highly satisfactory. Its advantages over the crude and immature systems in general use are manifold. Its operation is removed from the hands of the departmental foremen, who are liable to error in the handling of accounts, and costs of labor are made up by an independent clerk.

It is a ready check on all estimates, as it contains the cost of paper, labor by departments and materials, the elements entering into all properly prepared estimates. The dockets giving actual results are always accessible, in cases of request, for new estimates or repeat orders. Errors on the part of employés in making out their work tickets can easily be traced, and

excessive costs of labor in any department can readily be located and accounted for.

The file, with its "live" dockets, is a daily record of the work in hand and its present condition. It pro-



9 3-25 JOB WORK DOCKET. (ORIGINAL) No. J 1255

National Publishing Co. DATE Aug. 1 1903

WANTED August 20th. Ottawa

DESCRIPTION:

1,000 booklets, 6×9, 16pp.
L.P. type. black ink.
Cover ptd. two colors, wire stitched.

CHARGED Aug. 21 1903 AMOUNT $ 40.00

STOCK SUPPLIED WITH DOCKET.		$	C	TOTALS	
1 R. 1 O. S. 80 No. 1 25×37 PER RM. $ 4.40		4	62		
R. 10 O. 6 S. 50 R. mist gray " $ 10.00		5	12		
R. O. S.	" $				
R. O. S.	" $				
COVERS	PER $			9	74
PRINTING COST	COMPOSITION FROM WORK TICKETS	9	07		
	PRESSWORK FROM WORK TICKETS	3	11		
	COST OF INK		66	12	84
BINDING COST	LABOR FROM WORK TICKETS	1	72		
	MAILING AND POSTAGE				
	STOCK SUPPLIED		35	2	07
OUTSIDE WORK	PRINTING Electro 60				60
	BINDING				
	TOTAL COST			25	24

W. J. Foster — FOREMAN PRINTERY

C. Johnson. FOREMAN BINDERY

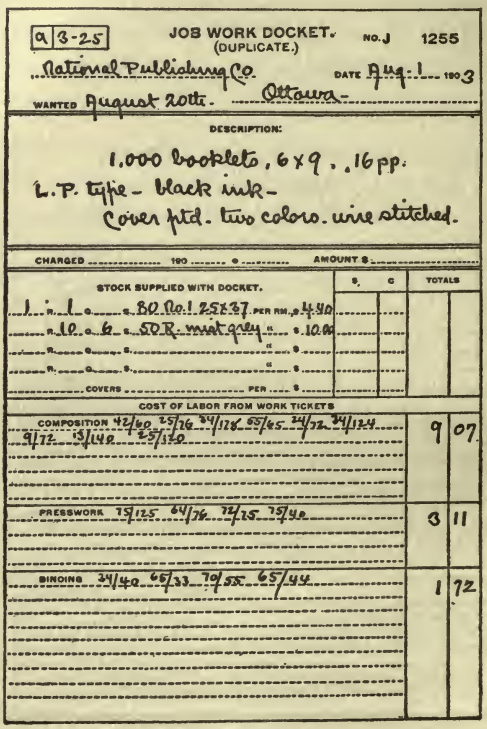
ENTERED IN REGISTER, PAGE 354 August 21 1903

H. — CLERK OF FACTORY

FIG. VI

vides an easy means of finding jobs that have been unduly delayed and of answering the varied inquiries for work which is in progress.

The above system of recording factory costs of production has proved of inestimable value to the printing and binding house in which it is being used. It is inclusive in its scope, yet it is so simple in its operation



9 3-25 JOB WORK DOCKET. (DUPLICATE.) NO. J 1255

National Publishing Co. DATE Aug. 1 1903

WANTED August 20th. Ottawa.

DESCRIPTION:

1,000 booklets, 6 x 9, 16 pp.
L.P. type - black ink -
Cover ptd. two colors. wire stitched.

CHARGED ..... 190 ..... AMOUNT $ .....

STOCK SUPPLIED WITH DOCKET.	$	C	TOTALS	
1 R. 1 @ 80 No. 1 25x37 PER RM. @ 4.40				
R. 12 @ 6 @ 50 R. mist grey " @ 10.00				
R. @ @ " @				
R. @ @ " @				
COVERS ..... PER ..... @				
COST OF LABOR FROM WORK TICKETS				
COMPOSITION 42/60 25/76 34/178 65/65 24/72 24/124 9/72 13/142 25/170			9	07
PRESSWORK 15/125 64/76 72/15 15/42			3	11
BINDING 34/40 65/33 70/55 65/44			1	72

FIG. VII

that it is readily understood, and it requires little time on the part of employés for filling in the required data. To the line of work to which it is applied it seems to

have overcome many of the difficulties which seem to affect the various methods of securing accurate records of costs of production. It is inexpensive both in its installment and in its operation, and has proven its effectiveness in actual trial—a trial that has been as severe as it has been satisfactory in its results.

CHAPTER XVIII

HOW FACTORY COSTS ARE FOUND

BY NORTON W. CHARLES

The competitive spirit of the business world of today has permeated through the outer strata of commercial organization and is now at the very root of

TO				WORKING ORDER NO.
Jno. Wilson —				5328
DEPT. M.S.	SEC 2	ASSIGNED —		
YOU ARE HEREBY AUTHORIZED TO DO THE FOLLOWING WORK, VIZ.				
5 N.G. Reservoirs. (C.L.)				
REQUISITION GRANTED FOR THE FOLLOWING STOCK, VIZ.				
12	lbs. Sheet C.			
1/2	" Rosin.			
1	set stock bolts:			
	nuts & washers:			
DATE 11/9/08		C. H. Gardner — SUPT.		

FIG. I; the foreman's order from the superintendent

enterprise and industry—namely, the factory and the workshop. No matter how large or how small the output, how great or how little the investment of capital, how sagacious or how limited the executive ability of the concern, there is demanded alike of all the final result of definite competitive quotation on standard prod-

ucts. The minor manufacturer, limited by capital, lack of organization or concentration of interests, or even by inexperience and neglect of system—in fact, not even so established that he may work together into an harmonious whole the different ends of his business, is confronted constantly by the problem of placing his goods upon the market at the same figure and under the same trade inducements as his stronger and thoroughly

MACHINE 16	CLASS 9	OPERATOR Martin —	
UNIT		ITEMS	
% 8		RENT	6 20
		INTEREST & DEPRECIATION	2 10
		NON-PRODUCTIVE LABOR	12 32
		HEAT & LIGHT	4 65
		TAXES	75
		MISCELLANEOUS	3 08
		1	
		2	
			29 10

FIG. VI; the shop expense record

equipped competitor. Time is too precious in which to experiment, the balance of power is all on the one side, and it becomes apparent at once that to apply the producing prices of the larger enterprise to the smaller forms a peculiar misfit. Therefore, a mechanical process by which the details of manufacture may be statistically arranged and compared becomes of inestimable value, and the only true and safe course for determining the cost of production.

Nothing appears to yield a better result than the versatile card systems. Added to this must be systematic arrangement of factory equipment, the intelligence of an able cost-figuring department, and, above all, perseverance in accomplishing the results sought. To illustrate the first point, let us diagram the factory arrangement and we find the following necessary departments and duties therein:

How a Factory is Organized for Application of a Cost System

I. Shop Order Department—(a) Analyzes orders. (b) Makes foreman's orders.

II. Factory Clerks—(a) Time charging. (b) Stock charging.

III. Stock Department—(a) Orders stock. (b) Raw stockrooms. (c) Store stockrooms.

IV. Shop Expense Department—Figures and allots shop expense.

V. Piecework Rate Department—Figures piecework rates.

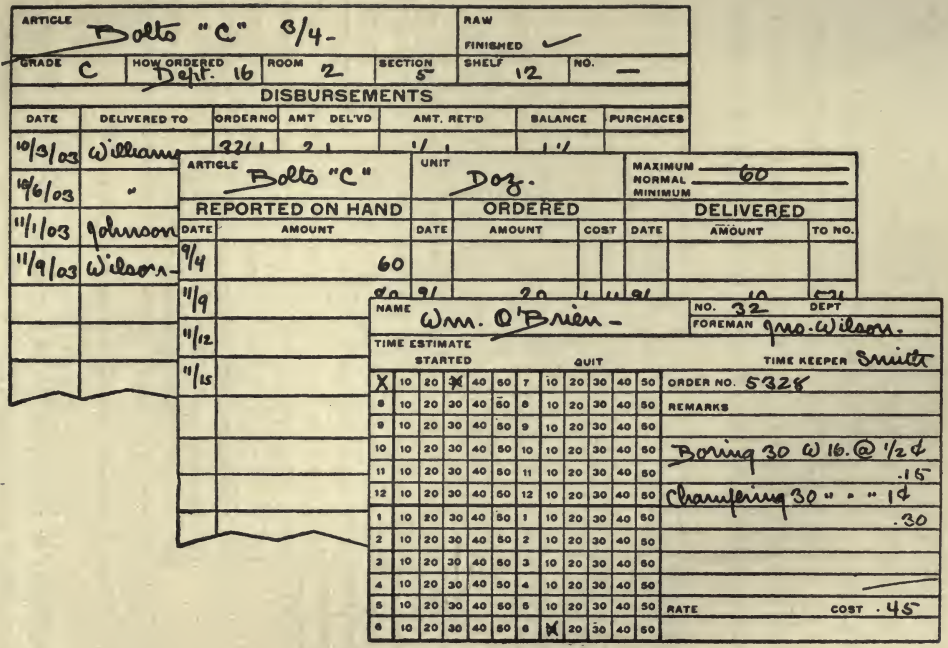
VI. Shop Schedule Department—(a) Schedules orders. (b) Sees that above are carried out by follow-up system.

VII. Counting or Transfer Room—In other words, the factory "clearing house."

VIII. Shop Ticket Department—(a) Assembles tickets. (b) Inspects tickets.

IX. Cost Figuring Department—Final Summary of Costs.

Of these nine divisions, it will be seen that com-



FIGS. II, III and IV; the requisition, the supply and the employés' time cards

binations may be made to reduce the organization into more general heads, but not to destroy their individual functions. But considering the above to exist as stated, let us take up an order in progress through the factory and see how the system may be applied. When the order comes into the factory, after receiving a house

HOUSE ORDER NO. 5328 DATE 11/9/08

C. H. Andrews — SUPT

NO.	ARTICLE	AMOUNT	DUE FOR TRANSFER	DEPT	FOREMAN
C.1	N.3 Reservoir	5	11/12/10 A.M.	M.S.	Wilson —
C.2	Ash Pans.	1	" 9 "	"	McCarthy.
B.3	P. & R	2-2	" " "	—	—
C.5	L. & S				

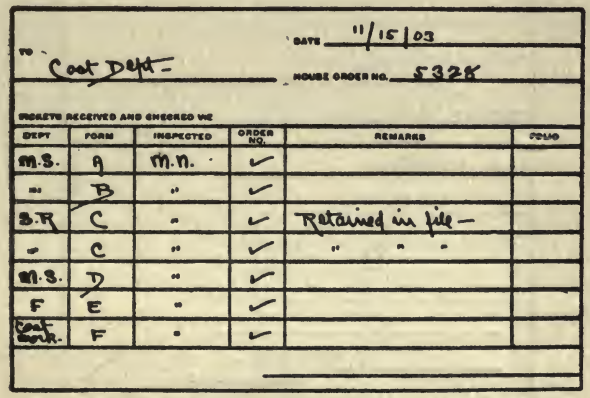
ARTICLE Range (body) GRADE A FINISHED PRODUCT CLASSIFIED

OPERATION	PER	STATE OF COMPLETION	RATE		MACHINE NO. 5
MOULDING		Finished	7	95	5
DRILLING		"	6		16
FITTING		"		79	—
MOUNTING		"		62	—
RIVETING		"	2	15	16
LINING		"	10	16	12
TOP ORNAMENT'N		"	8	40	4
POLISHING		"	1	75	7
CRATING		"	1	00	—
			85	52	

FIGS. VII and V; the follow-up card and piece-work record

number, it is delivered to the shop order department. the order is then analyzed by the superintendent and each foreman's work is outlined in Figure I (in this case for the completion of copper-lined reservoirs in a stove factory), together with a requisition upon the stockroom for the stock necessary in construction. Ad-

dition to such, if required, may be made only by the superintendent. Each foreman files these cards in order of completion, or may file ahead in case of rush orders. Every employé is provided with a time card (Figure II). These are filed in an open tray, under alphabetical guides (if collected), or upon board, with hooks convenient to section where used. Upon commencing the job, the workman indicates by cross at the proper hour and minute, as shown in the cut, and upon

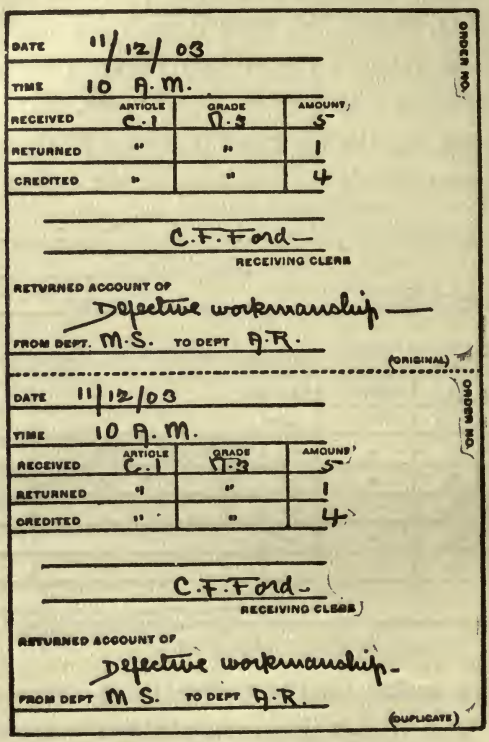

TO Cost Dept. DATE 11/15/03
HOUSE ORDER NO. 5328
COMPLETE RECEIVED AND CHECKED ME

DEPT	FORM	INSPECTED	ORDER NO.	REMARKS	TOTAL
M.S.	A	M.M.	✓		
"	B	"	✓		
S.R.	C	"	✓	Retained in file —	
"	C	"	✓	" " "	
M.S.	D	"	✓		
F	E	"	✓		
Cost Dept.	F	"	✓		

FIG. IX; where the shop tickets are checked

completion makes similar indication in the opposite square. Such time is then estimated and entered above by the timekeeper and indicated in his book as a check (together with all postponements on the job); the ticket accompanies the article as completed. From such a system, piece-work rates may readily be computed, and the encouragement of industry among workmen is evident.

When the truckman is sent to the storeroom for his necessary stock, he takes his requisition card as evidence. Upon Figure III the different articles, their


DATE 11/12/03
ORDER NO.
TIME 10 A.M.

	ARTICLE	GRADE	AMOUNT
RECEIVED	C.1	N.3	5
RETURNED	"	"	1
CREDITED	"	"	4

C.F. Ford
RECEIVING CLERK
RETURNED ACCOUNT OF Defective workmanship
FROM DEPT. M.S. TO DEPT A.R.
(ORIGINAL)

DATE 11/12/03
ORDER NO.
TIME 10 A.M.

	ARTICLE	GRADE	AMOUNT
RECEIVED	C.1	N.3	5
RETURNED	"	"	1
CREDITED	"	"	4

C.F. Ford
RECEIVING CLERK
RETURNED ACCOUNT OF Defective workmanship
FROM DEPT M.S. TO DEPT A.R.
(DUPLICATE)

FIG. VIII; how defective work is noted

location and other information are entered, and the clerk in charge, upon giving out any amount on a given requisition, enters it upon this card and credits back any amount of the material returned, thus keeping a

record of his stores, adding to such balance when replenishments come in. These acquisitions and the necessary indications to warrant them are entered on Figure IV, and by such arrangement the supply always exceeds the demand.

How the Shop Expense and Material Costs Are Found

For the purpose of estimating the cost on this article to be manufactured, a knowledge of the machine capacity is necessary, otherwise no piece rate could be established, nor non-productive labor (such as clerical hire) estimated. The shop expense department figures this capacity in reference to this single job (Figure V), and upon results, as previously summarized, the rates for piece work, as determined under the different operations, is entered on Figure VI. (It should be borne in mind that rent, interest and depreciation, non-productive labor, heat and light and taxes are all items of machine expense, and enter pro rata into the cost price of the manufactured product). These cards were kept in file under indexes to articles.

In order to insure the rapid progress of the order through the factory, the shop schedule department is supplied by the superintendent's office with Figure VII, upon which the different component parts are listed, together with the departments in which they are being constructed, and the time for their necessary transfer from said department. By the use of this card, filed under daily guides, this department can use a follow-up system and investigate delayed work under any fore-

man. When the job is completed, the foreman sends them, with his cards and orders relative thereto, to the transfer room. Figure VIII is filled out roughly in pen-

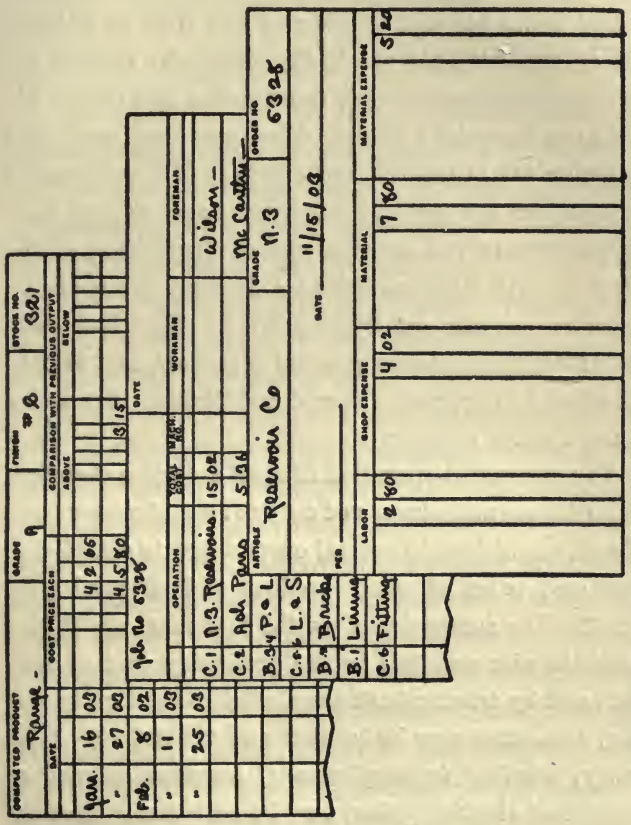
PIG IRON @ 500 PER TON	200	LBS.		150	ARTICLE Range —
MOULDING	3	62			
MOUNTING FITTING & DRILLING	5	02			
NICKELING	1	70			
			10	34	
EXTRA WORK & WASTE PR CT			2	15	
BOLTS, SCREWS & RODS	1	75			
KNOBS & HINGE PINS	2	10			
RIVETS & WASHERS	1	35			
ASH PAN	2	16			
POKER & TOWEL ROD		75			GRADE A
LIFTER & SHAKER		70			
STOVE BRICKS & MICA	1	16			
RESERVOIR	3	02			
DOOR LINING		92			
TOP ORNAMENT	1	00			STOCK NO. 321
OTHER ORNAMENT		75			
SHEET METAL FITTINGS	10	05			
CRATING	1	00	26	71	
WASTE AND LOSS PR CT			2	67	DATE 11/16/03
GEN. M'F'G EXP			7	75	
COST OF ARTICLE IN WAREH	51	12			
DISTRIBUTING EXP PR CT.	2	55			
COST OF ARTICLE WHEN PAID FOR			53	67	

FIG. XII; the costs of manufacture record

cil by the receiving clerk and the duplicate torn off (manifold carbon copy may be used) and handed him as evidence of the satisfactory completion of his work and a release from further responsibility. Any defective

work is deducted and returned; the original is forwarded with the job.

The shop tickets department now collects the dif-



FIGS. X, XI and XIII; the final summary cost cards

ferent tickets, checks them (after inspection of the job), and then stamps them "O. K.," or sends them, clipped together with Figure IX, printed on ordinary paper, to

the cost figuring department. Here the final summary is made on Figure X. Four items have entered into the cost of each article of the assembled whole, to-wit: Labor, shop expense, material and material expense, the last being the cost of placing any item of finished stock in condition for use in the particular article, for parts are continually being constructed and stored for use in the assembled whole. The total cost upon this particular job is entered upon Figure XI, with entire specifications for general reference upon Figure XII. Comparisons in the relative cost of production of the complete article (as on Grade A Range) are made by successive outputs on Figure XIII. This last card forms a separate file for general reference, and is filed under index to articles; the rest are filed together under the main order number.

The successful operation of such a system therefore enables the manufacturer not only to formulate accurate and safe quotations in special output, but to establish a listed cost price of every product and integral part thereof. The comparisons on the last form show at a glance the rise and fall in the producing cost of each order, and by tracing back the statistics relative to this order, the cause may be located and the defects of the factory, whether in employment, machine output, or purchase of stock supplies, may be remedied. Such results most certainly repay the cost of maintaining the system and justify every effort expended in its behalf.

CHAPTER XIX

THE COST OF PRODUCTION

BY CHARLES J. WATTS

To devise a simple, effective and economical system for securing accurate factory costs is a problem many manufacturers have yet to solve. In these days of fierce competition, the average maker of a standard line of goods is tempted to use the selling prices of his competitors as a guide in determining his own.

But he can not be certain that the result obtained by this means will insure a profit under the conditions peculiar to his factory. He is at all times confronted with the idea that his competitors may be more progressive and that the systems employed by them may facilitate the operations in their factories and thus reduce the cost of production. With this uncertainty of his competitors' methods and systems he can not with safety base his cost simply on their selling prices.

Again, the manufacturer who operates his factory on the basis of the cost of material and of flat labor, adding a percentage to cover non-productive labor, manufacturing expense and general expense, as well as contemplated profits, is no nearer solution of the problem of factory costs than the one relying simply on the prices charged for similar goods by other concerns.

In this chapter is presented a cost system, which, while free from all the intricate problems of a balance-ledger system, furnishes information sufficiently accurate for all practical purposes. It will also enable the progressive manufacturer to determine his own costs absolutely, as well as to point out to his superintendent any weakness existing in the operation of the factory and so provide for a speedy reduction of excessive expense in the cost of manufacture.

This system is a clear and concise statement of what the factory is consuming in labor and in material, as well as of its operating expenses. No profits are included.

As there are but five main accounts to be considered, it is more simple, but at the same time as complete and as effective as many which are more elaborate and complicated.

The terms and illustrations used in describing and explaining the workings of this system are taken from the author's experience in the manufacture of agricultural implements. They are simply illustrative. To apply the principles to the conditions existing in any factory it is only necessary to substitute for those used in this book, the terms and units of your own product.

The principal items which contribute to the costs in a factory, are material, labor, manufacturing supplies, special items of cost and general expense.

Material is the basis of manufacture and in a sys-

tem of factory costs it should be first considered.

Material

The illustration (Figure I) represents the cutting list or detail of one part; i. e., a shaft of a hay rake. In the same manner this detail arrangement may be applied to any standard line of goods manufactured in quantities, or to goods made up in advance of specific orders or sales.

The different kinds of materials used are specified under sub-headings, so as to permit of a summary being readily made of the totals required of any particular kind or class of material.

On the guide space of the front of the card is the part number and the name of the given part. Under this guide space is the name of the machine to which the part belongs. Under "Size and Dimensions" are the width, the thickness and the length of the wood used in this part. Next to this is the quantity in feet, hundredths of a foot, and in the several columns to the right are the numbers of pieces of this kind used on this implement. Following this is the column showing the kind of material used.

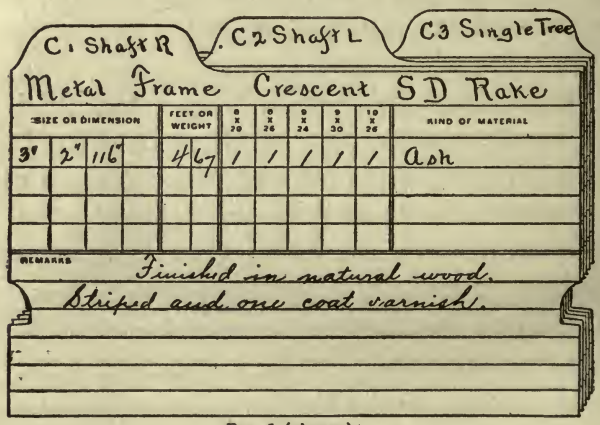
Below are spaces for three changes should the thickness, length, kind of stock, or other detail be changed.

The finish of the part or anything special is noted under "Remarks."

On the reverse side of the card is provided a space for recording the cost of labor, which will be referred to later on.

In describing the system, an 8 x 20 tooth rake will be used as an example. Other sizes would of course be computed on the same basis.

To arrive at the cost of material in this machine, complete, a material summary card, (Figure II) is used, which gives the totals in feet, pounds or count of the different kinds of material used, made up from separate detail cards (Figure I).


C 1 Shaft R
C 2 Shaft L
C 3 Single Tree
Metal Frame Crescent SD Rake

SIZE OR DIMENSION				FEET OR WEIGHT		8 X 20	8 X 26	8 X 24	8 X 30	10 X 26	KIND OF MATERIAL
3"	2"	116"		4	67	1	1	1	1	1	Ash

REMARKS: Finished in natural wood.
Striped and one coat varnish.

FIG. I (obverse)

In a rake of this kind the materials used are lumber, cast iron, malleable iron, common bar steel, spring steel, rake tooth stock, etc., as well as bolts, nuts, washers, hinge pins, cotters and other small stock.

In making up this detail (Figure I) there should be a card for each part, bolt, nut, washer, etc., so that there will be a complete list of all the materials in the implement. In case any parts are bought outside of the

factory, the detail cards (Figure I) can be ruled on the back to provide a space for keeping a record of the contract price in place of the labor ruling as shown, or the same labor ruling could be used, substituting the price in place of labor operations.

A total summary (Figure III) of material and labor, shows the complete cost of 100 machines. To arrive at this result the totals of the different materials,

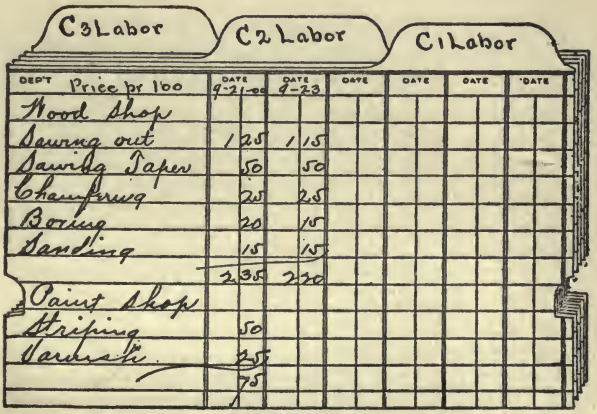


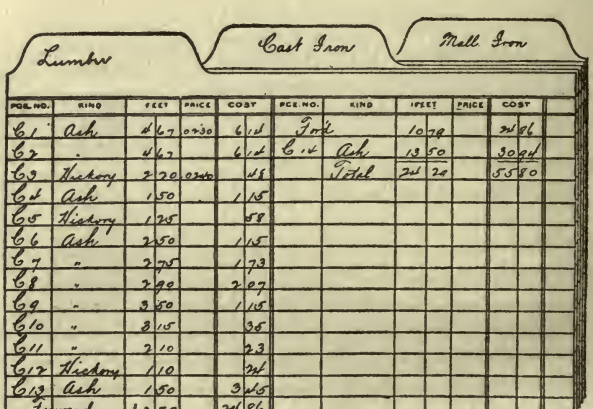
FIG. I (reverse).

as shown by the material summary cards (Figure II) are taken, for example, first the item of lumber, $55.80, was obtained from the card shown in Figure II. The other items in the summary were obtained in a similar manner.

While the cost of labor is also shown in this summary, the method of computing it will be explained further on.

These summaries are to be made up whenever a revised cost is wanted, as the cost of manufacture may increase or decrease with changing conditions of the labor or of the material market.

In computing costs according to this system only the actual amounts of material necessary to make the part have been considered and there must, of course, be an allowance for waste.



PCE. NO.	KIND	FEET	PRICE	COST	PCE. NO.	KIND	FEET	PRICE	COST
61	Ash	4 67	0.30	6 14	Iron		10 79		31 86
62	"	4 67		6 14	614	Ash	13 50		30 94
63	History	2 20	0.30	48		Total	24 29		55 80
64	Ash	1 50		1 15					
65	History	1 25		58					
66	Ash	2 50		1 15					
67	"	2 75		1 73					
68	"	2 90		2 07					
69	"	3 50		1 15					
610	"	3 15		35					
611	"	2 10		23					
612	History	1 10		24					
613	Ash	1 50		3 45					
Forward		33 79		74 86					

FIG. 11

This the foreman of the wood shop can estimate so that an accurate percentage can be added to the cost of the lumber. In this line of goods, the waste will average 20 per cent, while with castings, steel parts, bolts, nuts, washers, etc., 3 to 5 per cent will cover any ordinary waste.

As every progressive manufacturer contracts for material on the basis of a season's supply, it is not

difficult to determine the cost of the different raw materials.

It is recommended that the detail cards (Figure I) be made up on the detail side in the office and that the labor items be recorded on the cards by the clerks in the several departments through which the pieces pass in course of manufacture. They are then to be delivered to the cost department, where the cards (Figures II and

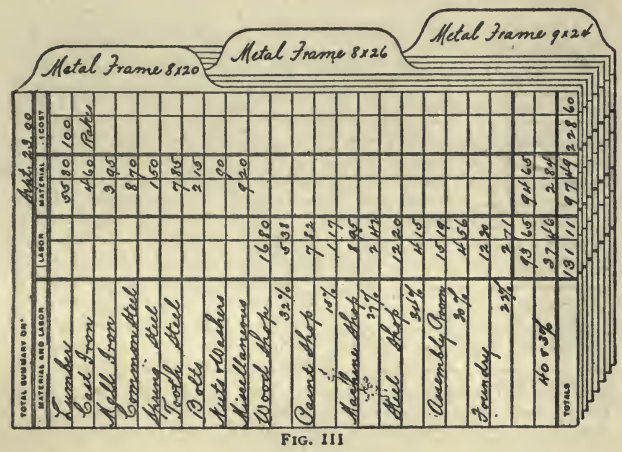


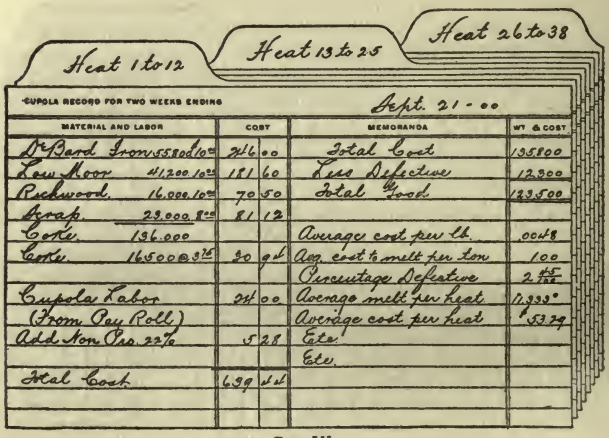
FIG. III

III) are compiled, after which all cards are kept in a cabinet in the cost department.

If any changes occur affecting the kind, cost or quantity of material, the clerk having charge of such details may either make the changes from time to time as they occur, or preferably by means of a notification slip advise the cost clerk of these changes. The latter can then record the changes at his leisure. This sys-

tem permits of a perpetual cost account being kept, since there is provision in both cards (Figures I and II) for recording such changes.

As many manufacturing plants make their own cast iron, they no doubt have a foundry statement showing the cost of melted iron from the cupola. But to make this simple system complete, we submit an easy method (Figure IV) for obtaining the cost of melted


Heat 1 to 12
Heat 13 to 25
Heat 26 to 38
CUPOLA RECORD FOR TWO WEEKS ENDING Sept. 21-00

MATERIAL AND LABOR	COST		MEMORANDA	WT. & COST
D^d Bard Iron 5580 @ 10^00	216	00	Total Cost	135800
Low Moon 41200 @ 10^00	181	60	Less Defective	12300
Rockwood 16.000 @ 10^00	70	50	Total Good	123500
Scrap 23.000 @ 8^00	81	12		
Coke 136.000			Average cost per lb.	.0018
Coke 16500 @ 3^75	20	96	Ave. cost to melt per ton	1.00
			Percentage Defective	2 1/2
Cupola Labor	24	00	Average melt per heat	11,333#
(From Pay Roll)			Average cost per heat	$ 53.29
Add Non Pro. 22%	5	28	Etc.	
			Etc.	
Total Cost	639	46		

FIG. IV

iron. The labor of the molders is recorded on the back of the detail card (Figure I) so that the material is figured separately from it.

To obtain the cost of one pound of melted iron from the cupola, the total cost of pig iron, scrap, sprues, gates and coke, together with cupola labor, is divided by the total weight of the good castings obtained from the heat. The result will be the cost per pound of

melted iron. Castings are figured at the cost of melted iron, and the foundry labor is added afterwards. This gives the actual cost per casting. For malleable iron the same general rule applies.

On this card (Figure IV) is kept the heat record of the foundry. These cards are filed in a cabinet and form an excellent comparative statement. Although different kinds of pig iron would not be bought at the same price per ton, a fixed amount is here used to simplify the example. It should be charged at cost.

Twenty-two per cent is added to the cupola labor for the non-productive labor, as it represents the per cent which covers the cost of foreman, rough labor, etc. in the foundry. This is fully explained further on.

The remaining entries on these cards not specifically referred to are self-explanatory, and will suggest for entry other items of information which will prove to be of interest and value not only to the superintendent but to the manager as well.

Labor

Of equal importance with the cost of the materials used in the process of manufacturing in determining the total cost of production, is labor. Labor, in manufacturing, is divided into three classes. Productive labor is that which produces something tangible and of asset value. In other words, it is the labor that from raw material makes a finished piece or part.

Next is departmental non-productive labor. This is that class of labor in each department which is neces-

sary to make the productive labor most effective but does not of itself produce anything. To be more explicit, a manufacturing department is generally made up of a number of men over whom is a foreman, and if the number of men be large there is a clerk also. There are also truckers, oilers, and a general class of roustabouts who must be maintained in the department in order that the producers may work to advantage.

In the plant must also be shipping and stock clerks, timekeepers, engineers and others who belong to no one department but who are a positive necessity in order that the producing departments may operate effectively. The labor of these is called general non-productive labor.

If $1.00 be the value of productive labor and to it be added 30 per cent as the value of the departmental non-productive labor, $1.30 results. To this is to be added the general non-productive labor which may be assumed to be 40 per cent of the total productive which will give $1.70 as the real cost of each $1.00 of productive labor in the department.

If the percentages above referred to are properly calculated, and to the cost of all the productive labor in the factory is added departmental and general non-productive percentages, the result is the exact amount of the pay roll for the term or period considered.

In order to properly handle the cost of labor it is recommended that piece prices be established in all departments which will not only simplify the matter of

records, but will also result in a saving in the cost of manufacture, as it is a well known fact that piece workers are prone to produce more work in a given time than day workers, the greater effort of each one being attended by a consequent gain to him in earnings.

All well conducted factories are divided into departments. Six departments will generally be sufficient

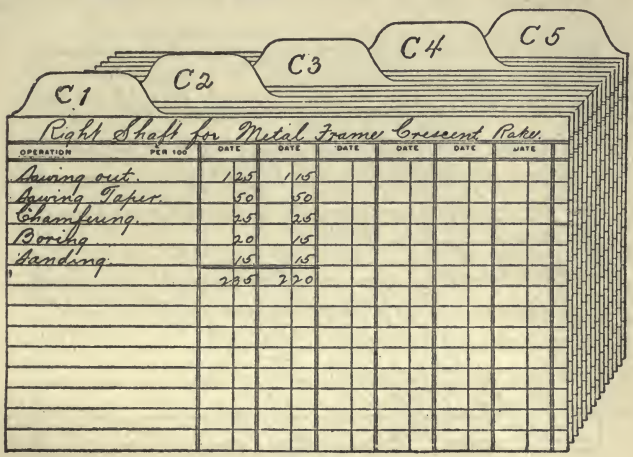


FIG. V

to cover all of the productive labor. These are usually classed as follows: Wood shop, foundry, steel or blacksmithing department, machine shop, paint shop and assembly room.

Since piece prices can always be closely approximated in each of these manufacturing departments, a small card cabinet is provided in which is kept a record of the piece prices paid for work in each department.

The illustration (Figure V) represents a convenient price card for the wood shop. On this card are the prices paid for the labor in the wood shop in making the piece named on the card which in this case is referred to as C1. As six columns are provided on this card for changes in cost prices it will last a long time.

Since in many manufactured articles certain parts are identical, not so many cards will be required as

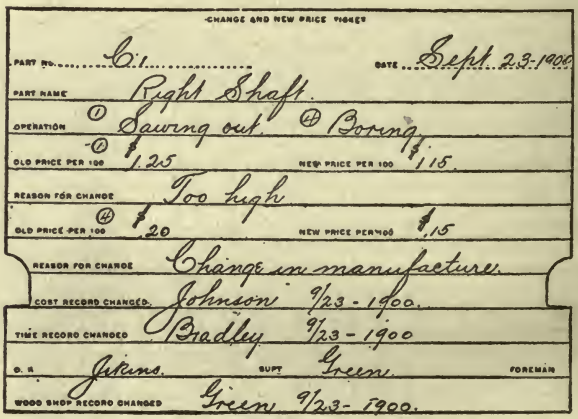


FIG. VI

would at first thought seem necessary. For example, in this case part C1 although belonging specifically to one particular rake, is also a part of other rakes and consequently this one card will suffice in making up the costs of all rakes in which this part is used.

The card authorizing these changes (Figure VI) is to be made out by the foreman of the department and sent to the superintendent for his approval. If

the superintendent approves of the change, the original and duplicate cards are sent to the cost clerk who signs his name to the original as evidence that the change has been recorded. The original is then sent to the timekeeper for his guidance in making up the pay roll. The duplicate is retained by the cost department and the change is noted on the reverse side of the detail card (Figure I reverse).

The original card is returned, properly signed by the timekeeper, to the foreman of the department by whom the notification card was issued. This now indicates to him that the change has been made in the cost department and the wood shop price card for the part C1 is now corrected (Figure V). These changes serve to keep the records accurate and show at any time the exact cost of labor in each department. Changes of this kind must, of course, be attended to promptly, so that each interested person may be advised of them on the same day. The figures in circles represent the numbers of the operations.

In addition to the piece-price cabinets in the different departments it is recommended that a large cabinet be kept in the timekeeper's office in which piece prices may be kept by the timekeeper so that the time cards may be checked. This constitutes a check on the different departments and insures the accuracy of the pay roll.

A simple form of time ticket (Figure VII) is presented which, with modifications, may be made to

answer for all departments. The example given (Figure VII) is the time card of a man working on the part C1 in the workshop.

These time cards are intended to be used by every man on the pay roll. The several departments are numbered. One to six may be the producing departments and numbers from seven onward may be applied to the non-productive departments, according to the division desired.

TIME CARD CHECK NO. 20

WORKMAN John N. Wilson Sept. 21 1900

Sawing out 100 C.1.

Order @ $1.25 $1.25

MORNING												AFTERNOON											
START						STOP						START						STOP					
6	10	20	X	40	50	6	10	20	30	40	50	12	10	20	30	40	50	12	10	20	30	40	50
7	10	20	30	40	50	7	10	20	30	40	50	1	10	20	30	40	50	1	10	20	30	40	50
8	10	20	30	40	50	8	10	20	30	40	50	2	10	20	30	40	50	2	10	20	30	40	50
9	10	20	30	40	50	9	10	20	30	40	50	3	10	20	30	40	50	3	10	20	30	40	50
10	10	20	30	40	50	10	10	20	30	40	50	4	10	20	30	40	50	4	10	20	30	40	50
11	10	20	30	40	50	11	10	20	X	40	50	5	10	20	30	40	50	5	10	20	30	40	50

FIG. VII

Of course, all departments numbered above six are for general non-productive labor except where the labor performed pertains to tools, patterns, permanent equipment, machinery, assets or permanent values.

These time cards should be marked as productive or non-productive by the foreman of the department in which the work is performed. This gives the time-

keeper the information necessary to separate the productive from the non-productive labor and will be described and illustrated later.

At 6:30 A. M. a workman, Wilson, receives his time card from the clerk or foreman and is assigned to his work. At noon he has finished this work and proceeds to fill out the card. He first inserts his check number, in order that the timekeeper may identify him on the pay roll, having previously checked in at 6:30 A. M. with this number. He dates his card, signs his name, indicates what he has done, crosses 6:30 and 11:30 in the hourly divisions and hands the card to the clerk or foreman at once.

After the noon hour he receives a new card and proceeds as before. As these time cards will be coming to the timekeeper's clerk at all hours of the day from men in the department, the clerk at once inserts the price as shown by the price card (Figure V), and computes the earnings, in this case, $1.25.

It is, of course, evident that the labor performed is productive and the card is marked "Prod," meaning productive labor. Should, however, the labor be such that the clerk cannot determine whether it is productive or non-productive he confers with the foreman. This same plan is pursued during the day and at the close of the day the clerk has all tickets computed except the last round turned in. These he computes as his first duty the next morning.

The clerk hands the day's time cards to the foreman for his approval or correction after which they are delivered to the timekeeper for the pay roll.

As all these cards are marked so as to separate the productive from the non-productive labor of the six manufacturing departments, the timekeeper is now in a position to ascertain each day or week, as may be desired, the departmental as well as the general non-productive percentage, the latter being a fixed quantity.

In computing the time as given by the time cards of a workman in any producing department, where the goods are run through in small lots, it is recommended that such workman receive credit on his ticket for the number of pieces made at piece-rate prices, and the balance necessary to make up his day's wages be allowed him at his day rate and be charged as non-productive labor.

For calculating the departmental percentages of non-productive labor "labor statement" cards are provided (Figure VIII).

The timekeeper having full information from the daily time cards received from all departments is able to divide the pay roll as shown. The total of the productive labor for the week divided into the total of non-productive labor gives the per cent of non-productive labor for the week. The "last week" item on the statement comes from a previous statement. The "to date" item includes the totals from the beginning of the fiscal year. These "to date" totals represent the amount paid in the

wood shop up to and including September twenty-second, resulting in an average departmental non-productive per cent. of thirty-two.

All productive or manufacturing departments are treated in the same manner, as well as the cost of that part of the labor in the non-productive departments which is productive labor when expended on tools, patterns, permanent equipment, etc.

LABOR STATEMENT

WOOD SHOP — WEEK ENDING 9/22/00.

DISTRIBUTION	PRO PIECE	PRO DAY	NON PRO	TOTAL
Pro. Piece Mks.	175 20			
" Day "		12 60		
Non Pro. Acct.			1 75	
" " Day "			72 20	
TOTALS FOR WEEK	175 20	12 60	73 95	261 75
TOTALS LAST WEEK	187 60	15 20	65 90	268 70
TOTALS TO DATE	1800 91	272 22	663 40	2736 53
DEPT NON PROD FOR WEEK			.3937 %	
DEPT NON PROD FOR LAST WEEK			.3352 %	
DEPT NON PROD TO DATE			.32 %	

FIG. VIII.

The method of obtaining the amount of general non-productive labor is as follows: If any productive labor has been performed in non-productive departments, that amount is added to the total of all productive departments. The sum of these is divided into the total of the non-productive departments after the amount of productive labor has been deducted.

From the "labor statements" of the various de-

partments (Figure VIII) a "labor summary" of all the departments is made up (Figure IX).

The per cent of general non-productive labor for the current week is readily determined by dividing the amount of productive labor into that of the non-productive labor. The item "last week" came from a similar summary. The 40 per cent non-productive "to date," we apply to the total amount of labor as shown on the card (Figure III).

LABOR SUMMARY — WEEK ENDING 9/22/00.

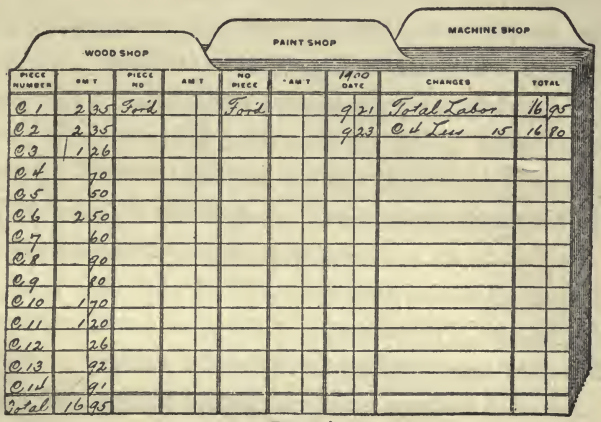
DEPT'S	NAME	PRO. PCE	PRO. DAY	NON PRO.	TOTAL
1	Wood	175 20	12 60	73 95	261 75
2	Paint	120 60	6 19	32 70	159 49
3	Machines	279 00	18 60	80 20	327 80
4	Steel	260 92	27 80	92 60	381 32
5	Assembly	115 87	8 96	40 24	165 07
6	Foundry	319 61	82 75	98 20	500 56
8	Shipping			75 80	75 80
9	Miscellaneous			129 50	129 50
	Total for week	1721 15	156 90	673 24	2001 29
	" Last "	1119 65	162 20	518 30	1800 15
	" to date	15892 20	1318 30	7629 75	24839 85
Est. Non Pro. for week				.3923	
" " " Last "				.4044	
" " " to date				.4012	

FIG. IX

The method of ascertaining and recording the proportionate cost of both the departmental and the general non-productive labor to the productive, usually considered a difficult undertaking, is by this system shown to be an easy and simple computation. The purpose of these percentages is to give the absolute cost of producing each part, which is obtained by adding them to the flat cost of each part which is already established since the work is done on a piece-price basis.

For convenience, these percentages are not applied direct to each part, but on assembly cards (Figure X) on which are collected the flat cost of each part as given on the reverse of the detail cards (Figure I reverse).

For illustration, the cost of labor in the workshop in producing of the part designated as C1 is assumed to be $2.35.



WOOD SHOP | PAINT SHOP | MACHINE SHOP

PIECE NUMBER	AMT	PIECE NO	AMT	NO PIECE	AMT	1900 DATE	CHANGES	TOTAL
C 1	2 35	Ford		Ford		9 21	Total Labor	16 95
C 2	2 35					9 23	C 4 Less 15	16 80
C 3	1 26							
C 4	70							
C 5	50							
C 6	2 50							
C 7	60							
C 8	90							
C 9	80							
C 10	1 70							
C 11	1 20							
C 12	26							
C 13	92							
C 14	91							
Total	16 95							

FIG. X

This amount is recorded on the assembly card (Figure X) against C1 and by the same method is charged up the flat cost of all other parts as C2, C3, etc., until all the flat labor in the wood shop is assembled, amounting in the illustration to $16.95.

It is presumed that on September twenty-third there is a change in cost (Figures V and VI) and it is so recorded on the assembly card (Figure X). There

being no further changes, this total, ($16.80) as the cost of the flat labor in the wood shop is transferred to the material and labor summary card (Figure III). After this total is also added the departmental per cent of non-productive labor for the wood shop, previously obtained (Figure VII).

The same method is followed with the cost of all the flat or productive labor in each department until the total cost of all the productive labor in all departments is obtained together with the non-productive percentage. This total (Figure III) is $93.65. To this total is added the percentage of the general non-productive labor which in this case being 40 per cent (Figure II) is $37.46, making the total cost of labor—productive and non-productive—$131.11 (Figure III).

To this is to be added the costs of material taken from the material summary cards, of which the lumber card (Figure II) is shown. This gives a total factory cost in this case, $228.60 for 100 8x20 rakes.

As total factory costs are needed but once a year, when prices are made for traveling salesmen, the total summaries (Figure III) are made up only at or near the close of the factory year.

As by this system an accurate general average of the cost of both departmental as well as the general non-productive labor is determined, and as most manufacturers make yearly contracts for materials, it is possible to compute the cost of all material at the new prices and obtain exact costs for the ensuing season.

It is also possible at any time during a season to make a close estimate in the same way of the cost of any new article or product by taking the cost of the material, adding the known cost of the flat labor with the "to date" labor percentages in all departments which are shown by the labor statements at that time.

Manufacturing Expense

The term "manufacturing expense" as used in this chapter includes the cost of the supplies used by the factory during the year, consisting of replaced belting, emery cloth, sand paper, planer knives, buckets, brooms, mops, stationery, fuel, oil and numerous other articles of a like nature. There are, of course, many ways of accounting for these items, but their inclusion in this division accords with the working of the other departments and will be found most satisfactory.

At the time the general inventory is taken let all stock of this class be carefully listed at its asset value, deducting a certain per cent for depreciation from the value of such articles as are worn or partly used. Having done this there is now in the factory only the raw material, permanent equipment, the product in course of manufacture, and the finished goods.

At the time of commencing operations, whether at the beginning of a new business or annually after each inventory, let each foreman draw from the stock room such supplies as he needs, a proper blank being provided for the purpose. It is necessary to advise the stockkeeper as to the cost of each article in this ac-

count. This may be accomplished by a system in the purchasing department whereby invoices for all goods received pass through the stock clerk's or storekeeper's hands.

Having received and filled the order from the foreman, the material drawn is charged to the proper department on a stock card (Figure XI). Let this card represent one article which in the illustration shows leather belting drawn for department Number One.

Have a card for each article, also a card for each department. As the usual list of supplies is not large it will not take very many cards for all of the departments. The stockkeeper should do all his posting from the foreman's orders to these cards once a day, and thus economize time.

This stock card shows the cost price and it is therefore not a difficult matter to enter the record in actual value of the supplies and not simply the quantities used. There are many ways in which the ledger can be divided, but it is recommended that there be used a card having a guide projection in the center and extending one-third of its length, for the division of the different kinds of stock, and a card with a tab (Figure XI) for each department.

As these tabs indicate the numbers of the department it is easy for the stockkeeper to locate any cards wanted when posting.

The system, once started, requires but little labor to keep up, and as a replacement is infrequent, the ex-

pense is small. If desired, the capacity of the cabinet may be enlarged and used also to keep a record of all material in the stock room, although for cost purposes it is not necessary.

The superintendent and the manager as well, will also find that a weekly report or manufacturing expense summary (Figure XII), made up from the stock cards (Figure XI), is very helpful in eliminating un-

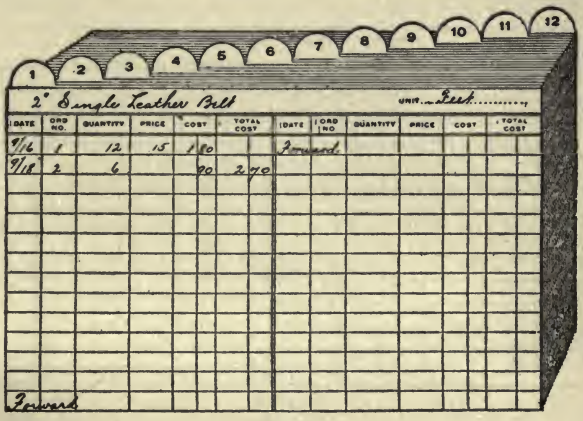


FIG. XI

necessary expense in any department. This report, either on a card or on a sheet, may accompany the reports of labor in the various departments (Figure VIII). These two reports show the actual cost of the labor performed and of the supplies consumed for the week, which may be discussed and analyzed with the foremen.

This weekly report of manufacturing expense also

serves as a basis for applying this expense to labor cost, either at the end of the season, or at any time during the season, when the factory costs of making any new articles of manufacture are under consideration.

In pro-rating this expense over the cost of the given article, it is recommended that the entire output of the factory be computed at prices derived from the cost estimates, and that this amount be divided into the

MANUFACTURING EXPENSE SUMMARY

WEEK ENDING Sept. 22-00.

MATERIAL	DEPARTMENTS 1	2	3	4	5	6	7	8	9	10	11
Belting	2 70										
Emery Wheels	9 60										
Files	2 60										
Twist Drills	1 20										
Brooms	1 50										
Etc.											
Etc.											
Etc.											
Etc.											
Weekly Total	16 60										
Last Week	15 70										
To Date	200 90										

FIG. XII

total cost of the supplies used. This gives the per cent which is added to the labor and material cost of the individual article to secure the net factory cost.

Of course, this per cent during the season could not be readily arrived at owing to the unfilled orders in the factory, but the total cost of supplies for years previous is known, and a per cent based upon this would answer for the special costs necessary to be estimated during the season.

If, in calculating costs at the end of a season for the succeeding season, it should be found that the proportion of supplies used is 10 per cent of the entire cost of the product, and the article in question costs $10.00, the manufacturing expense would, of course, be $1.00 for each article, which would be added to the factory cost.

General Expense

General Expense, in connection with a cost system, is to many managers a source of annoyance, and how to ascertain the proper percentage to be applied to the factory cost is a problem which is ever before them. Again, how to apply the anticipated profits has been a much discussed question with all. While it is not claimed that this method of treating general expense will satisfy every manufacturer, yet he will be convinced that if he will apply the items that go to make up general expense as here indicated, the estimated cost will vary but little, if any, from the actual costs.

The term, general expense, as here used includes such items as salaries, traveling expenses, taxes, insurance, uncollectable debts and notes, depreciation of product as well as of manufacturing plant, freights, telephone rent and telegrams, express charges, advertising and similar items of a miscellaneous nature.

There are two ways in which general expense can be arrived at for cost purposes. Either is sufficiently accurate to obtain satisfactory results, one having the

advantage of being short in application while the other is somewhat more difficult and tedious.

The simplest method is to keep a close account of all items entering into the general expense account as direct charges, and ascertain the total of this account for the year, adding a suitable allowance for uncollectable accounts, depreciation of product, plant, etc.

Divide this total by the total cost of the entire output less the value of material on hand as shown by the inventory. This result will be the per cent which is to be added to the cost estimate.

It is suggested that the salaries of traveling men and their expenses be kept separate and by districts or territories. This will make it possible to ascertain the cost per cent of selling in each district.

This separation is recommended, as many manufacturers well know that their selling expense in one territory is much greater than it is in others. This condition alone often prevents a concern from doing a profitable business in certain localities, which disadvantage would be removed by making each locality stand its own share of the selling expense, instead of pro-rating the entire selling expense over the entire product.

In the handling of a certain product one territory is known in which it costs 40 per cent of the selling price to market the goods, whereas in others it requires only from 3 to 5 per cent. If a district selling expense account is kept an expensive territory can be quickly

located and abandoned, if the resulting profit is not worth the time and expense required to secure the business. If the selling expense account is not divided in this manner, these facts are lost sight of. It can be done either by the ledger accounts or by a simple ruled distribution book or card file which the bookkeeper can keep without difficulty. If the latter is used, there is a card for traveling expense, for salary, and for any other incidental expense of the salesman in each district.

On the reverse side may be kept a daily, weekly or monthly record of the sales. At the end of the year a few simple computations only are necessary to arrive at the desired results.

The other plan of ascertaining the per cent of general expense to be added to the cost estimates, of which mention was made, would be carried out in the main in the manner just described, except that instead of waiting until the end of the season to apportion the monthly fixed expense, reserve and suspense accounts are opened in the ledger to cover such items of expense as are not directly incurred during the month in review.

In reserve accounts are included such expenses as cannot yet be exactly determined and whose payment therefore, must be deferred; for illustration, taxes. To this tax reserve account would be credited the estimated amount of the yearly tax, the same amount being charged to an Accruing Tax account. This amount would be pro-rated monthly into the general expense

account and the pro-rated sums credited to Accruing Taxes. At the end of the year, if the estimate was correct, the cash payment should close the Tax Reserve account and the pro-rated sums which have been credited monthly would close the Accruing Tax account. Other reserve accounts are handled in the same way.

Suspense accounts, which comprehend expense paid in advance for terms longer than a single month, are handled in the same manner except that the suspense account would be charged with the money paid and the amount pro-rated to general expense according to the number of months covered by the payments. For instance, if insurance premiums are paid six months in advance, one-sixth would be charged out each month so that at the end of six months general expense would have consumed all of this amount and the Advance Insurance Premium account to which is charged the cash payment, would be closed. Salesmen's expenses and other similar items are handled in the same manner.

The difference in the two methods is the difference between general expense known only at the end of the year and a definite statement of all general expense items for each month. The first is simple, and for yearly cost purposes is generally satisfactory, while the second method is equally good for yearly costs but also gives a monthly general expense statement, which for many reasons is preferable.

Either method can be used with a card system, thus reducing the cost of maintenance, or can be kept in the ordinary ledger.

Special Costs is a term used to include the extra items of cost arising from defective manufacture, the substitution of expensive material, such as brass in place of malleable iron, and such items as may result from oversight on the part of some foreman or other employé, or from a failure of prompt delivery of material. If these expenses cannot be traced directly to some source against which they may be charged, they should be borne by the specific part of the product affected and not charged over the entire product or to the general expense account.

Special Costs

It is suggested that a Special Cost account be opened in the ledger, covering such items and that this account carry this expense throughout the season, regarding it is an uncollectible account which is to be pro-rated over the cost of the product affected.

The natural inquiry is, "Why should this expense, incurred during the previous year, be added to the cost of the goods to be made the following season?" The reason is, if a certain amount is charged up during one season for oversight and errors, there is a strong probability that similar conditions will continue to exist, and an allowance should be made, as it would be for bad debts, interest on the investment, etc. This sepa-

rate account gives facts to work on, while if the items were merged in the general material accounts they would be lost sight of entirely.

To the cost estimates with all percentages included must now be added a certain per cent for profit. For example, assume twenty per cent as the desired profit, and $10.00 as the cost of producing an article in the factory, ten per cent as the per cent of manufacturing expense, fifteen per cent as the per cent of general expense, and five per cent as the per cent of selling cost, then $13.00 is the total cost of the article. If twenty per cent be added to this the selling price is $15.60 in the territory costing five per cent to sell in. This will assure you a profit of about twenty per cent on the money invested for the machine.

Profits

Now, let us consider the different cards and blanks and see how each may be elaborated to make a broader, but perhaps more complicated system.

The detail card (Figure I reverse) may be changed so as to provide a column for recording the price as well as the quantity of the stock with one or two additional columns for changes in price. This card then becomes a working price sheet, and when the non-productive labor percentages are added to these prices a cost record of pieces or parts is attained which furnishes a cost basis for prices of repair parts as well as for the inventory. As these cards are kept up they furnish a permanent corrected record of cost prices for

these purposes at any time they may be desired.

In making these computations for inventory purposes it is not recommended that the percentages for manufacturing and general expense be added. Annual inventory prices should not be inflated, and for this reason factory cost prices only should be used.

There is always a certain amount of stock taken into the inventory which is valued at the original cost while it has really depreciated. Taking the inventory at corrected cost prices will therefore in a measure, correct these errors.

The material summary card (Figure II) shows in this instance the total cost of lumber used in the 8 x 20 rake. From these material summary cards a computation may be made, showing the approximate number of feet of lumber required for each size and kind of machine made, thereby giving the required unit necessary for a given number of machines of each class. Further computations may be added, giving the total costs as shown by the cards. These furnish valuable data in estimating the requirements for the next season.

Further, if the cost of the labor on each kind of article as shown on the total summary cards (Figure III) is summarized, a very close estimate will be attained of the amount of money required for next season's labor.

These cards (Figure III) may be so modified that manufacturing and general expense are included with the factory costs. If this is done nothing need be

added to make the record complete but the selling price and the profit wanted. A column may be added in which to show the total feet of lumber, or the weight of the material.

By completing the records in this way, it is easy to make comparative yearly statements of the cost of material and labor and the percentages of expense and profit.

When the information on the cupola record (Figure IV) is complete there is still ample space for other information for the superintendent. For example, if it is desired to know the average cost of molding, add to the total productive labor in the foundry, the total non-productive per cent which in this case is (40); divide this amount by the total number of pounds of good castings and the result is the average cost per pound to mold for two weeks, the period of time covered by the card. This added to the cost of the melted iron gives the average cost per pound for castings.

The piece-price card (Figure V) may be ruled on the back in such a manner as to provide space for a record of orders received and parts made, taking the place of a department order book. This is particularly advantageous for the foundry and steel shops.

If the cards (Figure V) are of good material the items may be recorded in pencil, and at the end of the season this record may be erased and the cards used again.

While the time card (Figure VII) is intended for

the guidance of the timekeeper in making up the pay roll, it may be passed to the cost department and the labor recorded thereon entered on a piece-work record card (Figure XIII). This card shows the number of each piece made, at what time, by whom, the number of hours necessary in making, the total amount paid and the average rate per hour earned by each workman.

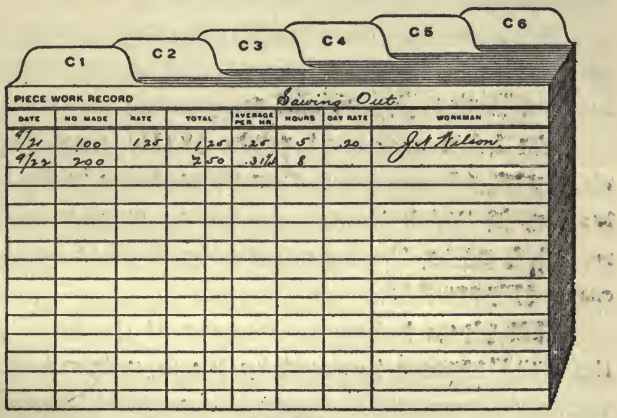


FIG. XIII.

This is useful information and is well worth the time and effort necessary to keep it in proper order, as it indicates whether the scale of piece prices paid is profitable or whether it should be revised. Then, too, the same cards may be used as a basis for opening a ledger account with each lot of goods going through the factory. To each account is charged all the labor and the material consumed in the process of manufacture

and the cost of the yearly production of any particular lot is shown, no matter when it was made.

By using order numbers in the factory for each lot of goods going through at one time, practically the same form of cards could be used by simply adding a place for the order number and charging the cost of labor to that number as well as the cost of all material drawn on requisitions correspondingly numbered. By this method the exact cost of the lot is obtained.

This, however, is bringing the system nearer and nearer to a balance ledger cost system and therefore becomes more expensive and complicated.

The labor statement cards (VIII) may be provided with columns other than those shown in the illustration, in which the manufacturing expense may be recorded, as on the manufacturing expense summary cards (Figure XII).

This places before the foreman of the department the exact expense incurred by his department during the week, from which report he may intelligently discuss with the superintendent the conditions in the factory, particularly in his own department.

Through these statements unnecessary items of expense are often discovered which can be eliminated, thus adding to the net profit.

Again, a column may be added in which the timekeeper may compute the per cent of piece work to day work, another column to show the number of men employed in the department and the average wage rate

paid per hour. A total summary of all this information may be made on the labor summary cards(Figure IX) covering all departments.

To this system for ascertaining factory costs may be added a system of inventories on cards which will show the number of pieces made and in stock, and their location in the stock or store room. The procedure in general is as follows:

When a lot or run of parts or pieces is started through the factory, it should be accompanied through all the various departments by a tag-board slip indicating the department which it is to reach finally, the number of pieces sent, the piece name or number, and any other information that may be necessary. This card should accompany the lot until it is put in stock or storage.

The assembly room should draw on this stock by requisition only. Then a record of finished parts in stock is easily maintained and the requisitions themselves show the quantities in the assembly room being placed in finished product.

The finished goods sent to the warehouse from the assembly room should be accompanied by transfer slips showing the exact number sent. The clerk in charge of the inventory cards, having received properly signed requisitions for the finished parts, makes the necessary changes on the records.

Such a system provides a simple record of all parts made and on hand, and if shipments are checked

against the goods in the warehouse a complete inventory results. Further, by using the record of costs as shown by the detail cards (Figure I) an accurate inventory with values can be compiled at any time.

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